FLIGHT

The AIRCRAFT ENGINEER & AIRSHIPS

First Aero Weekly in the World.

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

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DIARY OF FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in the following list:

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Feb. 15	**Lecture, "The Practical Aspects of the Seaplane," by Wing-Commander Cave-Brown-Cave, before R.Ae.S.**
Feb. 23	**Lecture, "Aerofoils," by Dr. A. P. Thurston, before I.Ae.E.**
Mar. 1	**Lecture, "Helicopters," by Major F. M. Green, before R.Ae.S.**
Mar. 1	**Entries close for the Schneider Cup**
Mar. 15	**Entries close for Dutch Height Indicator Competition.**
Mar. 15	**Lecture, "The Control of Aeroplanes at Slow Speeds," by Professor B. Melvill Jones, before R.Ae.S.**
Mar. 23	**Entries close for Gordon Bennett Balloon Race**
Apl. 12	**Lecture, "Some Controversial Points in Aircraft Design," by F. T. Hill, before I.Ae.E.**
May 11	**Lecture, "Experimental Flying," by Maj. M. E. A. Wright, before I.Ae.E.**
June 25–30	**International Air Congress, London**
June 30	**R.A.F. Aerial Pageant**
July	**Air Race for King's Cup**
July 20	**Gothenburg Exhibition**
Aug. 6	**Aerial Derby**
Aug. 6–27	**French Gliding Competition, near Cherbourg**
Aug. 8–12	**F.I.A. Conference, Gothenburg.**

EDITORIAL COMMENT.

OWING to the fact that these notes are written before the Third Air Conference at the Guildhall has closed, it is difficult to express an opinion as to what success has attended the event which may now be accepted as an annual one. Opinions differ as to the value of such conferences, some denying that they serve any useful purpose whatever, others maintaining that they are of the very greatest importance It all depends upon the point of view. Of direct utility there may be relatively little, but indirectly we are certain that the air conferences do in fact result in a very considerable amount of good. Not only do the papers read before the conferences usually give rise to useful discussions, but the conferences give the Government, through the Air Ministry, an opportunity of stating its views and policy (if any) and of "meeting its critics face to face," as General Brancker said in his paper on Tuesday.

The Air Conference

Opinions are expressed in the papers, different views, often opposing, are brought out in the discussions, and suggestions are made which are given the serious consideration of the Air Ministry and Cabinet. One is prone to assume that this is somewhat by way of being eyewash, but, as a matter of fact, there is good reason to believe that many of the suggestions made last year have borne fruit, and that many of the causes for criticism have been removed.

Furthermore, the air conferences serve to bring into closer touch those interested in the constructional and operational sides of aviation on the one hand, and those likely to make use of air transport on the other. Besides which the general public learns, through the Press (or should do so), what is the present position of aviation, what success has been attained, and what are the plans entertained for the future.

As Sir Samuel Hoare pointed out in his opening address, what is wanted is to get away from headlines and down to a quiet and instructed discussion. An instructed public opinion is and must be the greatest aim of all who wish to further the cause of aviation, for thus, and thus only, can we hope to make sound and lasting progress. Unfortunately, although without exception the papers read before the conference this year were of a nature calculated

to promote general knowledge, it is to be feared that certain sections of the Press failed to grasp the really significant passages, and gave much publicity to things which should have been referred to incidentally only, if at all. Thus it is scarcely helpful to make a great shout about the statement by General Brancker that some day we shall, by flying at great altitudes, be able to travel at 300 miles per hour. The "uninformed" (in a technical sense) sections of the general public are likely to assume that these figures refer to the immediate future, and when nothing happens (at least within the short-lived memory of the public) the momentary interest, or even enthusiasm, is likely to be followed by apathy, if not by actual distrust and hostility. We are not presuming to blame General Brancker. He was referring to a future achievement for which the present appears to hold out hopes, but if some means could be found to prevent the sensational expressions and "scare," headlines which certain sections of the Press invariably adopt when the subject is aviation, we feel that a great step would be made towards that informed public opinion which, we entirely agree with the Secretary of State for Air, is one of the first tasks with which the supporters of aviation are faced.

"Seaplanes" This week we commence publication of the papers read before the Air Conference by placing before our readers the paper read by Mr. C. R. Fairey, Chairman of the Fairey Aviation Co., and also Chairman of the Society of British Aircraft Constructors. Mr. Fairey's paper is of more than usual interest, not only because it deals with a subject which, although it is perhaps not generally appreciated, is of vital importance to the British Empire, but also, and even more so, on account of the point of view from which Mr. Fairey has chosen to treat his subject. We have had many papers on seaplanes, most of which have been published in FLIGHT, but we say without hesitation that we have never had a paper of more general interest than that read by Mr. Fairey before the Air Conference. Whereas other authors have dealt with the design, the construction and what might be termed the theoretical and engineering side of the subject, Mr. Fairey has taken up the practical, or operational, aspect, treated, in other words, the seaplane from the user's point of view, and has stated admirably and clearly the difficulties connected with handling and using seaplanes. This is a side of the question which has, we fear, been rather overlooked in the past, and we are quite certain that Mr. Fairey's paper will have done a tremendous amount of good by helping not only the non-technical, but even specialists to a broader and more comprehensive understanding of the problems, advantages, and disadvantages of the seaplane. There is only one slight criticism which we should like to offer. Perhaps Mr. Fairey did not give quite so much prominence as he might have done to the very great possibilities of the amphibian. For the long air routes of the future, except those purely over the sea, or entirely over land, the amphibian, in spite of its present incomplete development, may conceivably play a very important part, and it is a type which should be developed alongside of the seaplane.

With the opinion expressed by Mr. Fairey that for the smaller sizes the float seaplane would appear to be the most economical, while for large machines the flying boat seems to be the most promising type, we are in entire agreement, as also with the statement that, whereas the land machine appears to be nearing the limit of its size, the same is not the case with the flying boat. In fact, this view has been expressed in FLIGHT more than once, and we are extremely glad to have the confirmation of an authority such as Mr. Fairey. Last year the subject of seaplanes was omitted entirely from the Air Conference programme. This year the type has had an extremely able champion, and we do not doubt that a great deal of good will have been done for the cause of marine aircraft.

Metal Construction In this issue of FLIGHT we publish an account of a set of all-metal wings built in America to take the place of the standard wooden wings of a flying boat. The weight of the standard wings was 1·682 lb./sq. ft., whereas the metal wings came out at the very low figure of 1·088 lb./sq. ft. The construction is unusual in that tubes (mild steel) are used for the spar flanges and diagonal ties. So far as can be gathered, the wings have withstood sand tests successfully, and after the tests were passed as fit for actual flying tests, after, of course, having been conditioned. These wings afford a very interesting comparison with the French methods of metal construction recently described in FLIGHT, and with the methods of metal construction in vogue in this country, and in Germany.

In France Duralumin is the metal mostly used, owing to the cost of steel. It is used in various sections, mostly simple rectangular section tubes, but sometimes in the form of built-up box sections or open channel sections.

In Germany we have the Junkers tubular construction, also in Duralumin, and the Dornier construction, which is mixed, steel being used for highly-stressed members and Duralumin for the rest. Dornier uses half-tubes, or D sections, for his spar flanges and channel sections for the diagonal ties.

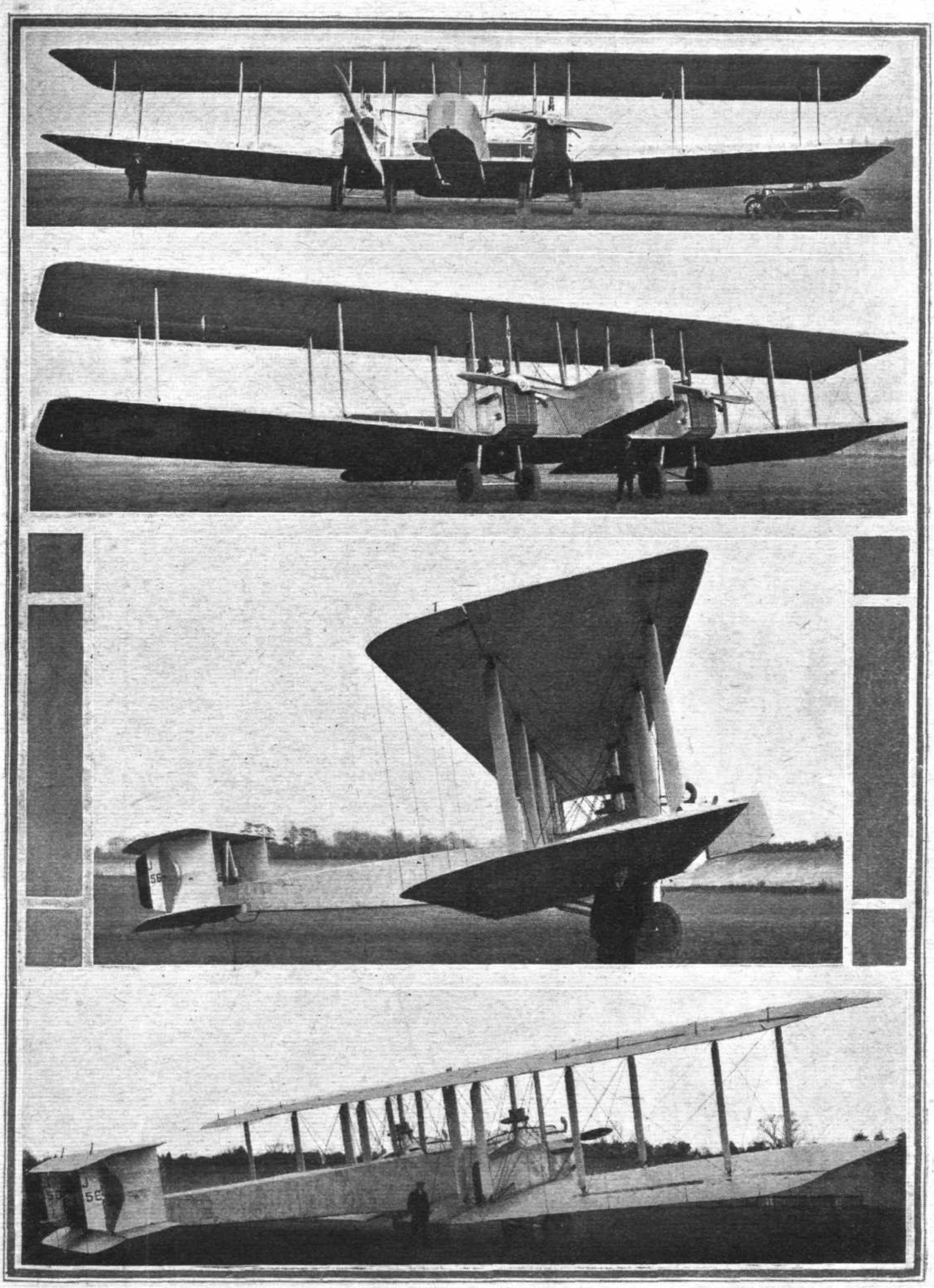
In this country we are not using Duralumin at all, and most of the metal work done has been with rolled sections of very thin steel sheet, joined by a considerable number of rivets. The question naturally arises: Who is right? We think it may very well be that the future will show a combination of the various methods, or at any rate of the best of them, to be the solution. In the meantime work is progressing, and the next year or two should provide informative data on what is at present a vexed question.

U.S. Representative of F.I.A.

THE National Aeronautic Association of U.S.A. is now the sole aeronautic authority in the United States representing the Fédération Aéronautic Internationale, this authority having been granted at a meeting of the F.I.A. on January 2 last. The headquarters of the Association are at 26, Jackson Place, Washington, D.C., and the President is Howard E. Coffin.

U.S. Air Mail Wins Collier Trophy.

THE Contest Committee of the National Aeronautic Association of U.S.A. have awarded the Collier Aeronautical Trophy, for the greatest achievement demonstrated in the actual use of aviation in America for the year 1922, to the personnel of the U.S. Air Mail Service The Committee in their deliberations brought out the facts that the Air Mail flew 1,727,265 miles, and of all trips scheduled 94.39 per cent. were carried out on time—the machines leaving and arriving as per schedule. This included 7,887 trips, of which 2,433 were conducted in rain, fog, or snow. During this service 1,224,723 lbs. of mail were carried, most of which meant a gain of one business day by the sender and receiver. It may be of interest to note that most of the equipment used by the Air Mail Service are remodelled DH-4 Army machines built during the War.



THE VICKERS "VIRGINIA": These four views have been passed for publication by the Air Ministry, but no detail description may be given. The machine is fitted with two Napier "Lion" engines. The motor-car and men in the photographs give a good idea of the size of the machine.

THE THIRD AIR CONFERENCE

VISIT TO CROYDON

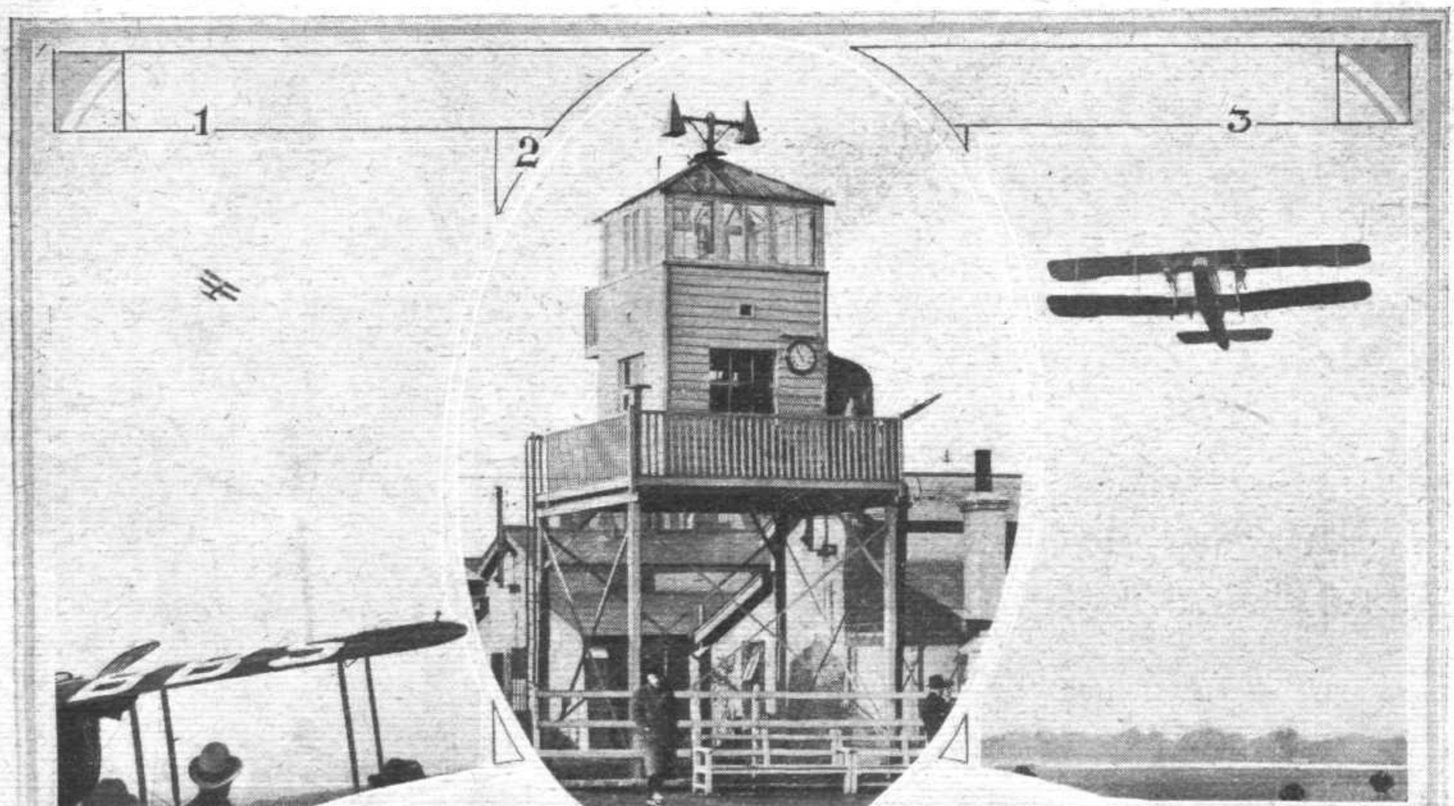
IN one way the delegates to the Air Conference were unfortunate when they made their preliminary visit to the London Terminal Aerodrome at Croydon on Monday. Although the weather conditions at the aerodrome itself were none too bad, over the Channel and France thick fog prevailed, with the result that traffic to and from the Continent was held up, and the delegates were thus unable to witness the arrival and departure of machines under actual conditions. True, a couple of machines started from Croydon, but they returned shortly after owing to thick weather conditions.

However, the three hundred or so visitors had plenty of other important and interesting things to see on the aerodrome itself, and if they did not see any actual traffic flying, they were able to witness demonstration and exhibition flights by a variety of types of commercial aircraft. Many, also, availed themselves of the opportunity of taking flights in certain of these machines, and apparently quite enjoyed their experiences. The machines "on view" consisted of the usual Continental 'buses, such as Handley Page W.8.B's, D.H.34's, 18's, etc., Farman Goliaths, and Fokkers, whilst the Bristol Pullman biplane made its reappearance on the 'drome and in the air. The Daimler Co.'s D.H.34, "G-EBBS," with its record 110,000 miles without once landing outside an authorised aerodrome, was one of the "star turns."

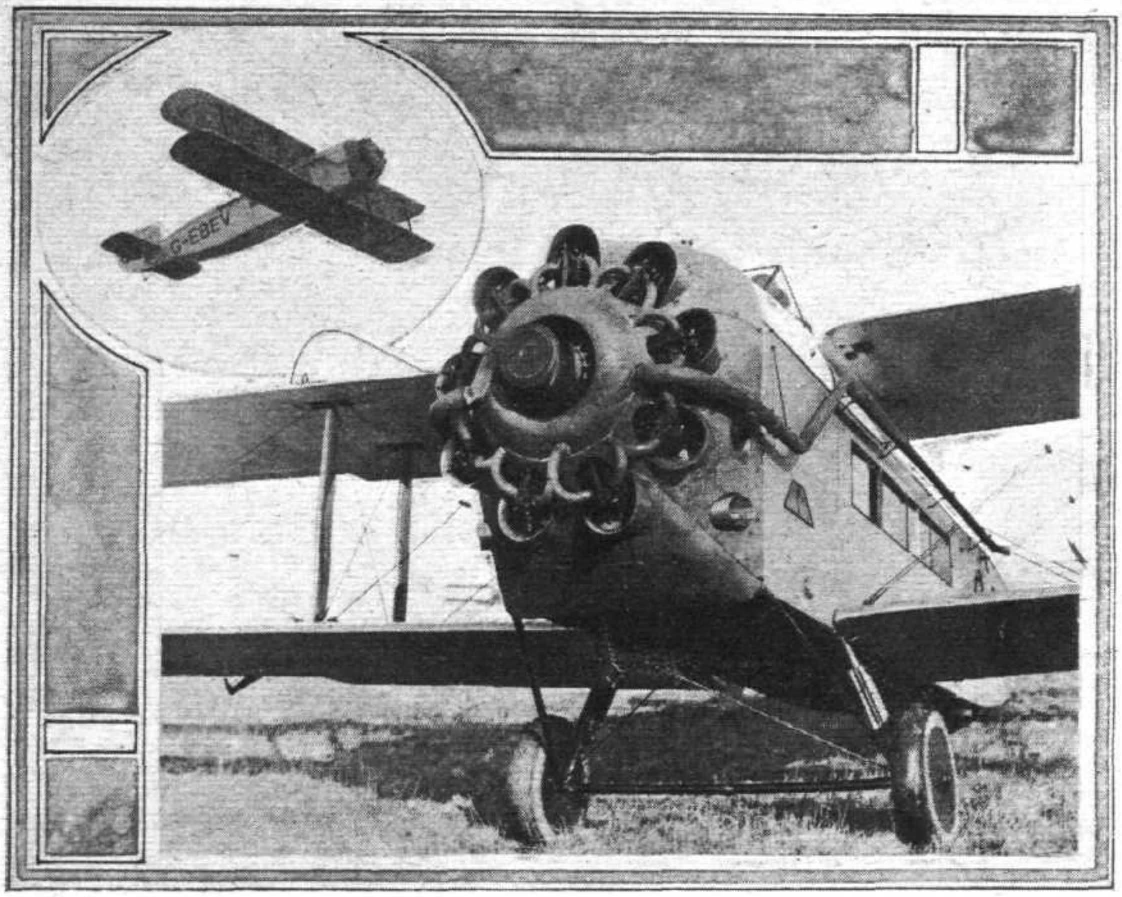
"Jimmy" James put up an exceptionally fine performance on the Gloucestershire "Mars I," including wonderful climbs, fast-and-slow flying, etc. The Aircraft Disposal Co.'s pilots, Maj. Foote, Mr. Perry, and Mr. Shaw, also gave some very fine demonstrations on sundry A.D.C. Martinsydes, D.H.'s, etc.

Meanwhile, the Conference delegates, "personally conducted" by Brig.-Gen. Festing—of course, Maj.-Gen. Sir W. S. Brancker, Director of Civil Aviation, was present—were being initiated into the mysteries of the aerodrome and its various workings. We do not at the present juncture propose to describe in full what was disclosed to the interested groups of visitors, for it is our intention to do so in detail in a future issue of FLIGHT. Suffice it to say that not only was the general organisation of the aerodrome and the Continental traffic fully explained, but the various offices directly and indirectly concerned were inspected. Of these perhaps the most interesting was the Central Control Tower from which a Traffic Officer constantly on duty—not the same one, of course!—is able to control all aerial traffic on the various routes and on the 'drome. Night flying arrangements, both the permanent and the experimental ones being used on the trials commencing that same evening, also created general interest.

Just as the visitors were leaving the aerodrome the large Avro bomber, fitted with the 1,000 h.p. Napier "Cub," arrived from Farnborough, where it had been delayed by fog. Several other interesting Service machines were, we understand, similarly prevented from visiting the aerodrome.



AIR CONFERENCE VISIT TO WADDON: 1. Mr. James demonstrates the speed and climb of the Gloucestershire Aircraft Co.'s "Mars I," with Napier "Lion" engine. 2. The wireless control tower. 3. A Handley Page W.8.B, with Rolls-Royce "Eagle" engines, takes up visitors. 4. Two of the Instone Air Line D.H.34's, with Napier "Lion" engines, are greatly admired by visitors.



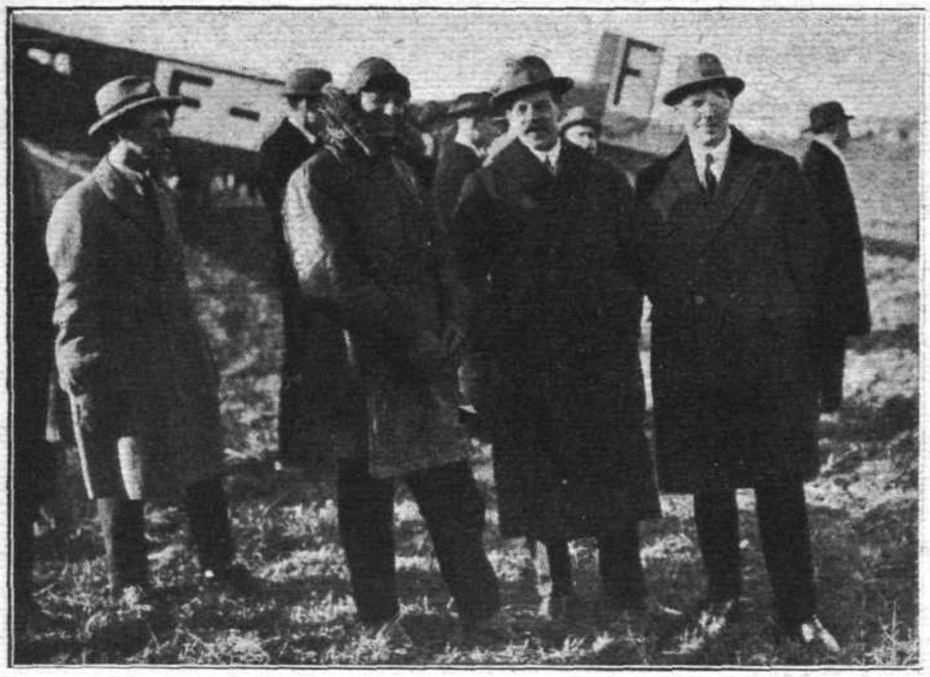
The New "Jupiter" Cowling on the Bristol Pullman biplane: Inset the Pullman in flight, carrying a number of visitors.

AIR CONFERENCE AT THE GUILDHALL

FOLLOWING the visit to Croydon Aerodrome, Waddon, on Monday, the reading of the papers was opened at the Guildhall on Tuesday, February 6, at 10.30 a.m. by the Lord Mayor, when a very large and distinguished company filled the hall. After a brief speech by the Lord Mayor, an address was read by the Chairman, Sir Samuel Hoare, Secretary of State for Air, who welcomed all present, and stated that he had been in office but three months, and that a much longer apprenticeship was necessary to enable him to give any opinion worth having, and that in the circumstances the only value his observations could have came from the fact that he had studied the problem of military and civil aviation with a completely impartial mind. He then proceeded to give some first impressions, reserving himself the right to modify them if they should prove wrong.

The Secretary of State for Air pointed out the two very considerable obstacles to the progress of civil aviation—shortage of money, and the after-War confusion of the world. It was, Sir Samuel said, very difficult to develop aviation without considerable expenditure, and at the moment it was not easy to find the money. With regard to developing civil aviation when the world was living in an atmosphere of war, Sir Samuel called attention to the practical difficulties arising in arranging air routes when one did not know from month to month whether the aerodromes of this or that country would be open to one. As long as we were living in this atmosphere of war, and as long as the world was in this state of confusion and uncertainty military aviation must have the first and principal call upon the nation's purse.

SOME CONFERENCE VISITORS TO WADDON: From left to right the following may be identified: Mr. T. O. M. Sopwith, Viscount Curzon, Mr. Wallace Barr, Col. Alec Ogilvie, Sir Henry White-Smith, Gen. Festing, Capt. Barnard, and Mr. H. T. Vane.



AT WADDON ON CONFERENCE DAY: From left to right: Mr. Olley and Mr. Wilcoxson, two of the Croydon pilots, Mr. Scott-Hansen, of the Norwegian Legation, and Major Grant, of the A.D.C.

Representatives of two British Air Lines: Mr. E. Cogni, manager of Handley Page Transport, and Mr. Instone, of the Instone Air Line.

"Personally," Sir Samuel continued, "I regard the huge expenditure of the world upon soldiers and ships, and armies and fleets, and air squadrons as an intolerable burden upon trade and industry, and indeed as an outrage upon Christian civilisation. But until there is a new spirit in the world, and until we have got out of this atmosphere of wars and rumours of wars, we cannot afford to let our air defences fall below the Empire's needs. This is not the time for me to discuss the very urgent question of what our air defences ought to be. Permit me only to say that at the present moment they are very low as compared with other great powers, and there does not seem to me to be the least possibility at the moment of any reduction. This being so, it is inevitable that whether we like it or not the greater part of the national expenditure upon air must, for the present, go to our military commitments of home and Imperial defence."

The Secretary of State for Air did not, however, wish to leave the question at this point, as it would then be said that he had no policy, and that neither this nor any other Air Conference was any good. If he gave that impression he would be misrepresenting his position. He was, he said, trying to develop a consistent civil aviation policy, and for weeks past he had been studying various schemes for setting it in the way of organic development.

Sir Samuel Hoare assured his audience that he fully realised the importance of research, and that although progress was hampered by financial difficulties he was only too anxious to see further development.

Concerning the aircraft industry Sir Samuel said:—

"The aircraft industry is a small industry in point of numbers, but it is a vital industry, and contains brains and hands that if they were once lost might never be recovered. I have visited one or two aircraft works, and I hope to visit several more, and I own that I have been struck by the very high standard of inventive ingenuity and technical craftsmanship that I saw there. It would be a calamity not only to civil aviation, but to all aviation, if the British aircraft industry came to an end. My first act as Secretary of State for Air was to obtain the permission of the Government to go on with the Home Defence development scheme, and I hope that this expansion will not only strengthen our air defence, but also give a stimulus to the industry. Let my first ministerial act be regarded as symptomatic of the fact that I should regard the disappearance of the British aircraft industry as a national calamity."

On the question of air lines in operation or suggested, Sir Samuel said that he was anxious to base his policy on two foundations, the first of which was that a sufficiently long period of contract should be granted operating companies so as to enable them to sink capital and develop their routes. Then, he said, there should be as little interference as possible on the part of the Government. He also expressed the view that no subsidy system should be arranged in such a way that it would hamper the very useful work being done, whether by air-taxi journeys or by certain small unaided enterprises.

Sir Samuel was very anxious to see a start made with an Imperial air route, but the decision did not, he said, rest entirely with him, and was a matter for the Cabinet and for the Dominions as well. In this connection Sir Samuel referred to the useful work being done by the Cairo-Baghdad air mail service, pointing out that 28 per cent. of the mail to Baghdad is carried by air.

The journeys were, he stated, made with remarkable regularity, and the saving in time was two days as against 21 to 23 from Cairo to Baghdad. When Sir Percy Cox had to attend a Cabinet meeting in London he was able to arrive in 9 days instead of 27 to 30 days.

Sir Samuel concluded by stating that it seemed to him that what was chiefly wanted was an instructed public opinion. We did not want air questions discussed in an atmosphere that jumped from extreme pessimism to extreme optimism, but what we did want was to get down from headlines and wild promises to an atmosphere of quiet and instructed discussion and development.

In the afternoon Sir Henry Maybury presided at the Conference; on Wednesday morning the Duke of Sutherland, Under-Secretary for Air, was Chairman, Sir William Joynson-Hicks, M.P., occupying that position at the afternoon Session.

The first day was devoted entirely to the reading of the papers, the discussions being relegated to the second day.

Among those who received invitations to attend the Conference were:—

Lord Desborough, Sir Charles Bright, Brig.-Gen. Sir Capel Holden, Maj.-Gen. Sir H. M. Ruck, Lord Edward Gleichen, Admiral of the Fleet Sir Henry Jackson, Sir Alan Anderson, Sir Samuel Instone, Mr. Handley Page, Sir Henry White Smith, Sir Edward Manville, Mr. A. Sturge, Mr. W. A. Bulkeley Evans, Capt. P. D. Acland, Mr. John Lord, Mr. T. O. M. Sopwith, Mr. A. J. Rowledge, Maj. F. A. Bumpus, Brig.-Gen. W. B. Caddell, Capt. G. de Havilland, Col. Barrett Lennard, Rear-Admiral C. T. M. Fuller, Brig.-Gen. F. H. Williamson, Col. A. M. Moens, Maj.-Gen. J. T. Burnett-Stuart, Lord Gorell, Lord Londonderry, Lord Morris, Lord Nunburnholme, Lord Peel, Lord Riddell, Lord Sydenham, Sir Arthur Shirley Benn, Maj.-Gen. Seely, Maj.-Gen. E. D. Swinton and Mr. Holt Thomas.

There were also present representatives of many aeronautical, scientific, engineering and industrial societies, Members of Parliament, and representatives of the Dominions, of Government Departments and of Municipalities.

SYNOPSES OF PAPERS READ AT AIR CONFERENCE

TUESDAY and Wednesday of this week were the two days set aside for the third Air Conference "called by the Air Ministry to provide an opportunity for the examination and discussion, by representative members of all sections of the community, of the problems associated with the development of air transport." The first day, February 6, was devoted to the reading of five papers, a *résumé* of which follows, while on February 7 discussions of the various papers took place. It has not been possible for us to include in this issue of FLIGHT a report of the discussions, but we hope to do so in next week's and subsequent issues. The five papers and their authors were as follows :—

"THE POSITION OF AIR TRANSPORT TODAY"

By MAJOR-GENERAL SIR W. SEFTON BRANCKER, K.C.B., A.F.C., Director of Civil Aviation, Air Ministry.

1. General Introduction.

2. Ratification of the Air Convention and Establishment of the International Commission for Air Navigation. The opening meeting of the Commission in Paris. The meeting in London. Its achievements up to date.

3. History of Air Transport in England during the past year.

(i) Services financially assisted by the Government.

Opening of new subsidy system on April 1, 1922—three firms running to Paris and one to Brussels—failure of scheme owing to small volume of traffic and excessive competition—crisis during May, 1922—compensation to operating companies for losses sustained. Introduction of a new system of subsidies on October 1, 1922—no competition between British lines—British activities extended to Cologne, Amsterdam and Manchester. Difficulties arising in connection with services into Germany—present situation.

(ii) Unsubsidised undertakings.

The de Havilland taxi service. The Savage sky-writing company. Joy riding. Air racing—The King's Cup.

(iii) General *résumé* of British progress in Europe.

Carriage of letters and parcels—carriage of passengers—accidents—improvements in regularity—increase in work performed by each aircraft and engine—medical statistics.

(iv) General progress of air transport in Europe.

(v) Air transport in our Overseas Dominions.

(vi) Airships—Commander Burney's scheme.

4. Consideration of Criticisms and Suggestions made at the last Air Conference (by Colonel Armstrong, General Brancker and others).

5. The Civil Aviation Advisory Board.

(i) Its creation and work.

(ii) The organisation of an air route to the East.

(iii) The London terminal aerodrome.

6. Relations between Civil and Military Aviation.—The creation of civilian flying schools—the value of air transport as a military reserve.

7. The Future.—When will air transport pay its way ?—factors in progress towards this end—technical improvements—administrative improvements.

8. General Conclusions.

"THE ESTABLISHMENT OF A SELF-SUPPORTING AIRSHIP SERVICE"

By COMMANDER C. DENNIS BURNEY, C.M.G., M.P.

Introduction.—The establishment of a self-supporting airship service involves many difficulties of a financial, political and technical character, all of which require investigation.

Value of an Airship Service.—The benefits that would accrue from the successful establishment of an imperial airship service may be divided into three groups :—

(1) The imperial and political advantages of a safe and cheap form of transport that would provide for the British Empire the equivalent of the through trunk railways of America, in so far as mails and passengers are concerned.

(2) The value in war-time of a fleet of airships together with their fuelling bases all over the world.

(3) The value of a service operated on a profit-making basis by a commercial company with British capital

Prospects of a Commercial Airship Company earning Profits.—*Résumé* of commercial work carried out—recent technical developments and their effect on revenue-earning capacity of the airship—estimates for bi-weekly service to India.

Financial and Political Difficulties.—These sides of the problem should be investigated on the basis that airships will eventually be self-supporting.

The Financial Problem.—The necessity for a large initial outlay, and the means by which this can be provided. A proposal to provide funds and form a commercial company to build a fleet of airships and operate them on a bi-weekly service to India with a weekly extension to Australia.

The Political Problem.—The late Government's attitude to airships necessitates making out the case for State assistance on the basis of the airship uses in naval warfare.

The probable effect of an air fleet organised as a fighting unit—the aeroplane the gun of the airship—the greatest striking power is the large airship carrying aeroplanes—the limited radius of action of the aeroplane is remedied by the airship carrying aeroplanes. Battleship and Air Power—the two schools of thought—the function of the British Navy—the political object and the military method by which that object is attained.

Method of Development.—Development of the Royal Navy showing how the lessons of history point to the necessity of developing airships on a commercial basis.

Conclusion.—Airships should be developed upon a commercial basis, and when the natural growth of scientific development renders a divergence of type between the reconnaissance or auxiliary vessel and the trading vessel desirable and necessary, then that is the moment for the commencement of a State service or Navy of specialised fighting airships.

"THE PROGRESS OF RESEARCH AND EXPERIMENT"

By AIR VICE-MARSHAL SIR W. GEOFFREY H. SALMOND, K.C.M.G., C.B., D.S.O., Air Member for Supply and Research, Air Ministry.

1. General Considerations.—Research on wing sections in connection with getting-off and landing speeds.

Three classes of problem in design : (i) single-seater fighters ; (ii) amphibians, reconnaissance machines, etc. ; (iii) civil aeroplanes, night bombers, etc. Load factors—strength of materials and their bulk production. Fuel research.

2. Aero Engines.—Requirements for Service and Civil aviation. Variable pitch propellers—Supercharging—The connecting rod big-end loading question—Use of Diesel cycle—Direct fuel injection—the Callendar electric air flowmeter for testing aero-engines in flight—Problems of the magneto.

3. Aeroplanes.—Low-speed landing of fast machines—Control at low speeds. Wind-channel tests : correspondence with full-scale investigated in case of common biplane form. Airscrews in close tandem form—Position of fuel tanks—Metal propellers—Under-carriages—Metal Wheels—Variable camber gears—Metal construction.

4. Gliders and Gliding, etc.

5. Navigation and Instruments.—The magnetic compass (new types)—Measurement in flight of speed and direction of wind—The Bubble sextant—Landing in fog—Aerial survey—Wireless.

6. Materials.—Weight and strength the important considerations—Study of fatigue limits—Use of duralumin for instruments.

7. Inspection Methods.—Difficulty of obtaining suitable steel—All-metal construction—Fuel specifications—Welded joints—Spectroscopic examination of metals.

"GLIDERS AND THEIR VALUE TO AERONAUTICAL PROGRESS"

By COLONEL ALEC OGILVIE, C.B.E., F.R.Ae.S.

Early experiments with gliders—Essential difficulty of the first step in flight—General aeronautical position in 1890—Experiments of Lilienthal, Chanute and Wright brothers—Development of practical flying—Progress during the last fifteen years—Present position of aeronautical development—Recent gliders in Germany, France and Great Britain—Their limitations and usefulness at the present day—Efficiency—Control at low speeds—Other possible uses—Value of competition.

THE fifth and last paper read before the Air Conference was by Mr. C. R. Fairey, and as it dealt with a subject which is of the greatest importance to the Empire we are publishing it almost in full. A few sections of the paper have been summarised, but in the main it may be considered a verbatim report except for certain references to illustrations, which were not available.

SEAPLANES

By C. R. FAIREY, M.B.E., F.R.Ae.S.

In his introductory remarks Mr. Fairey pointed out that whereas the design of aeroplanes early settled down into practically one universal type, the tractor, the seaplane is still in an unsettled state. He called attention to the fact that coastal harbours, rivers, and inland lakes provide natural "aerodromes" for seaplanes, and that in certain districts of Canada and Russia seaplanes can be used over country where aeroplanes could not fly with safety. Turning to the use of seaplanes by the Navy Mr. Fairey said:

"From the Naval point of view, whatever may be done with specialised aeroplanes operating from carrier ships, it is obvious that conditions will set a strict limit to size of such machines, and for big range reconnaissance at sea and for carrying big loads for offensive operations the development of the seaplane is the all-important factor that should not be neglected."

The lecturer then turned his attention to the two main types under which seaplanes may be classified, *i.e.*, the flying boat and the float seaplane, pointing out that each has its advantages and difficulties, and that preference for one type or another is mostly dictated by local requirements.

After referring to the advantages and disadvantages of single-step and two-step flying boat hulls, to shape of bottom (*i.e.*, flat or vee), etc., Mr. Fairey went into the problems of the float type of seaplane, which he sub-divided into two main types, single float and twin-float machines. As in the case of the flying boats, the float seaplanes were again sub-divided into single-step and two-step classes, and the peculiarities of each dealt with.

Generally speaking, Mr. Fairey continued, it would appear that the average advantage lies with the float types for small machines and the flying boat type for large ones, but this point of view must be modified if any one feature of either type is desired in preference to an average of superiority. Also this choice has one serious drawback, as both the single-engined float and the multiple-engined boat types have unprotected propellers, a feature which involves considerable difficulty in the design and is the principal objection to both types.

On nearly every point mentioned the writer will have to refer to this question of boat *v.* float when features of either type crop up in relation to the other, so that it can be left to the discussion to bring out the main points at issue. The chief divergence of opinion is in the question of seaworthiness, and here it is that thorough full-scale experiment could do more than debate. At the same time it is suggested that the two types are not really competitive in most respects, and that both will survive for their special purposes.

Practical Problems

Seaworthiness.—The question round which the greatest controversy has raged is that of seaworthiness, and this term is not usually properly defined. The conditions of seaworthiness must first be studied, and are usually totally different when the machine is under power, or if it is to be assumed that the engine has failed and the machine is adrift. The very qualities which make for improvement in the one case are frequently a disadvantage in the other.

If we first consider the case of taking off the water, we find it brings out a marked divergence as between the single-step and the two-step types. The two-step endeavours to adhere rigidly to a certain angle of attack on the water, and even at considerable speed there is not sufficient air control to regulate this angle through a very large range. With the single-step the machine is not stable on the water fore and aft when hydroplaning, and all the control must come from the air surfaces, but a very large range of control is available, and can be used by the pilot to ride over a rough sea which the two-step type, either boat or float, tends to plunge into.

In this connection it is interesting to compare for the twin-float type the difference in behaviour between the single step-type of float and the two-step, or alternatively the long type of float, naturally stable on the water.

Take the case of the single-step type, with no buoyancy aft of the step and with the tail end of the machine supported on a quite heavily-loaded tail float, the pilot when hydroplaning has the maximum control of the angle of the machine immediately the tail float is lifted clear of the water and the machine is poised upon the area immediately in advance of its single step. There is not even a buoyancy chamber aft, as with the intermediate type, to interfere with this control. Obviously this type of machine is easy to manipulate over a swell by use of the air controls.

Now considering the type with long floats, the machine will endeavour to maintain its own angle and there is a strong tendency to plunge into an advancing sea. The advantage is obviously with the single-step type.

But when we consider the reverse case, when the engine has stopped and the machine is assumed to be adrift with the sea anchor out and is head on to the sea and drifting astern, it is obvious that the heavy loads imposed on the tail float apply serious stresses to the fuselage at or about the region of the pilot's seat, with consequent risk of break-up and loss of the machine, and these loads are accentuated by the wind load on the wings, which are presented at a considerable angle of attack In the case of the long float, however, the machine rides on the water without involving any stress on the fuselage other than that due to weight, and the wings are presented to the wind at a lower angle of attack. We have here two opposite cases of seaworthiness, in which one type or the other gets the advantage according to the conditions.

In the intermediate type an attempt has been made to compromise between these two and obtain as much as possible of the advantages of both.

When landing on the water the conditions again favour the single-step type, as the angular range available can be used by the pilot to make a landing in the best attitude possible, and there is no risk of a sea striking the stern of the float so far aft as to cause an upsetting couple throwing the machine over forwards. The same comparison could be made between boats of the single- and two-step types, but the difference here is not so marked.

In connection with taking off on smooth or rough waters it is interesting to note that one of the worst conditions is that of a swell on a smooth sea in practically calm air.

Another important condition for seaworthiness is that of turning across wind. Under these conditions a large upsetting couple is applied to the wings tending to tilt the machine over sideways. This is a maximum at about 45° to the fore and aft line of the machine, and necessitates in the boat or single-float types the use of very large wing tip floats, and gives to the twin-float a considerable advantage.

Other seaworthiness conditions are largely structural and at variance with the structure weight. Large reserve buoyancy in hull and wing tip floats will give greater safety at the price of increased weight and head resistance, and naturally the stronger a float is built and the more bulkheads are included the heavier it must be.

Similarly light fabric covered wings cannot possibly withstand the force of the water when conditions are rough enough for seas to break over them, and it is a difficult matter in the boat type to give the lower wing clearance in this respect. The metal cantilever wing is here a great advantage. Fabric covered tail planes and elevators are easily damaged for the same reason.

Undoubtedly the ideal wing would be planked all over and strong enough for a man to walk over. Here there are great possibilities in the cantilever form of wing construction wherein the skin is stressed as part of the structure.

Seaworthiness is largely a matter of size in seaplanes as in ships, and seaplanes cannot reasonably be expected to be any better than their equivalent size in boats, and yet flying boats have been successfully handled in a sea which motor boats of equal displacement could not negotiate. In large sizes the improved structure weight of seaplanes will give an available margin of weight to be used for their improvement in seaworthiness and local strength.

The conditions of taxying or handling at slow speed in relatively smooth water present very little difficulty by the use of a suitable water rudder inter-geared with the air rudder. Machines can be handled at low speeds with ease, and can be navigated with the same facility as a motor boat. Some types have shown this same navigable quality without the use of water rudders at all. In coming up to an anchorage and for ease in picking up a mooring the advantage is greatly with the boat type, which can be handled in a similar manner to a motor boat. With the twin-float special mooring gear has to be arranged whereby the machine can over-run the mooring, which has to be picked up from the rear cockpits, but in bringing up the slipway the twin-float is superior, as it can be driven direct on to the slipway under its own power, the flat bottoms of the floats and absence of the keel enabling this to be done without risk of damage.

When used from rivers or lakes of small size many of these seaworthiness conditions do not have to be studied, and the corresponding saving in structure weight can be used to the advantage of the machine in load carried or performance, which is also desirable from the point of view of quick take-off with a view to clearing trees or obstacles on the banks.

Handling.—The present methods of handling seaplanes, in launching and bringing them ashore, can be described as deplorable, and is the chief obstruction to their greater use.

and until these methods are improved must be a bar to their commercial use except in certain special cases.

I refer to the use of inclined slipways coupled with beach axles. The machine is brought up to the slipway, and a special beach axle shaped to the bottom of the float or hull is attached in position underneath it by men in waders. The machine is then hauled ashore by winches or man-power. The reverse case is used in launching, and the machine is retained on the beach axle for the purpose of handling on land.

For small or large machines the method has hardly been improved in ten years, and the resulting damage to machines and the expense of operation accounts not only for the unpopularity of seaplanes for certain operations, but also for the nearly prohibitive cost. Many improvements have been suggested, some highly practicable, of which only a few can be mentioned. Possibly the discussion will bring out some further improvements.

For small machines in sheltered water the tidal slipway designed by Mr. Oswald Short is one of the best and most practicable methods. In this a pier extends out into the river or harbour, and attached to its end is a floating pontoon of such size that when a seaplane is alongside and broadside on, the wing tip clears the pier. The pontoon is anchored to the pier, but arranged to rise or fall with the tide. A large crane with sufficient throw on the arm launches the machine in the water clear of the slipway, so that the machine can be brought up in any state of the tide for loading or unloading without the use of waders or undue amount of labour. One of the greatest advantages of the amphibian also lies in the fact that it can be taxied under its own power up or down the slipways, and so gets over the principal difficulty of the ordinary seaplane. In view of the fact that for pure seaplane purposes the amphibian has certain disadvantages as to weight and head resistance, it would seem possible for ordinary seaplanes to mount small wheels in the floats themselves of insufficient size to cause serious resistance in the water, to be used in place of the beach axle. These wheels, which would not be large enough to enable the machine to be used as a true amphibian, would give all its advantages in this respect, but without the corresponding disadvantage of increased weight or water resistance.

Another very practical suggestion, also due to Mr. Short, is that of the floating shed which is mounted on pontoons and has a hinged slipway, projecting into the water. The machine is taxied on to the slipway, which can be lifted by compressed air. Similar sheds in which the machine is floated direct under cover are also possible.

For large machines with proper anchorage there is no necessity for bringing them ashore after every flight, but as such machines are preferably housed under cover, it would be a great advantage for stations to be constructed with canals leading right into the sheds in place of roads and a system of locks for bringing the machines in. If it were desired to have access to the hull below the water-line it would be possible to arrange for the pumping out of the basins inside the shed, so that the machine could be settled down on the proper shaped stocks. This would have the advantage that the process of getting the more or less delicate hull supported would be done with the machine not exposed to the wind. The original cost of such a station would be repaid by the decreased amount of damage to hulls when handled by present methods. A good step in this direction is the Admiralty experimental floating slipway now under test, and a further experiment is being carried out with a beach trolley for larger machines fitted with floats controlled by compressed air and arranged to be submerged under the machine.

Although in some situations seaplanes can be moored for long periods, and are best operated from moorings, it is essential that such a mooring should be extremely strong. No anchor of sufficient weight can be carried on the machine itself, since mooring a fully-rigged seaplane is analogous to mooring a yacht with the sails set, and there is the further objection that considerable water soakage takes place and materially increases the weight of the hull. With improved float construction, and possibly with the use of metal hulls, it is possible this objection will be overcome.

The question of handling seaplanes is one of the greatest importance, since small machines cannot be moored for long periods, and in fact large boats of the F. type have been known to "kite" at their moorings in a gale, and until the mechanical difficulties of reefing or folding wings on the water can be overcome with the resulting increased difficulties of stability when so folded or reefed, proper housing is essential except in very sheltered places.

The handling of seaplanes on the water, alighting, taking off, and navigating in restricted spaces, presents special problems to the pilot. The aeroplane pilot has one landing problem alone—sufficient room and wind direction. The seaplane pilot when landing head to wind may be dead across a tide of 8 or 10 knots, which would be equivalent to landing with considerable drift. It is a remarkable fact that experienced seaplane pilots appear to be able to see the tide even in unknown harbours, and to make a correct landing, splitting the difference between wind and water speed.

Many of the problems of operating seaplanes concern the organisation and accommodation of stations rather than the machines themselves, and this aspect of the question has been much neglected. Also it must be observed that seaplanes could be much improved in seaworthiness and handling qualities if data from practical experience were available to designers, and this can only come with development under working conditions.

Problems of Design

It is, of course, impossible in the scope of a single paper to deal with even a small fraction of the problems in seaplane design, since such questions as hull and wing construction, stability in the air or water, water resistance, etc., could not be more than adequately dealt with if a separate paper were devoted to each subject. The writer only proposes to touch on one or two outstanding points which most affect the comparison with the aeroplane.

Water Resistance.—The principal features that affect the design of seaplanes as compared with aeroplanes are, the water resistance of the hull or floats, which in addition to imposing limits on the surface and power loading have considerable effect on the propeller design, and the influence that type, arrangement, and dimensions have on the structure weight. Each type of seaplane has its special problems in stability, control and strength of structure.

Much research on the characteristic behaviour of various types of float and hull forms has been done by Mr. G. S. Baker of the National Physical Laboratory, and it is only possible here to deal with the general case.

It is a common characteristic of all usual float or hull forms that the resistance rises rapidly with the speed to an initial maximum known as the "hump" speed, after which the resistance falls more or less, and as the total weight is by then partially air-borne and the propeller efficiency is improving with the speed, the worst condition in taking off the water usually arises at or about this speed. Some hull shapes develop two such "humps."

The hump speed has two principal effects on the machine design. In the first case a margin of power must be allowed so that the machine can pass the hump speed with a reasonable acceleration, and this in itself is a limiting factor as to the total weight per h.p. to be carried. Secondly, it affects the propeller design owing to the necessity for obtaining considerable thrust at low forward speeds, with correspondingly bad effect on the top speed of the machine.

Assuming that machine and propeller are designed for taking off on smooth water in a flat calm, it will be satisfactory under most average conditions. Conditions likely to prevent the machine leaving the water are either rough water or the case mentioned before of a swell and a flat calm.

With early seaplanes the hump speed curve projected through that of the power available in nearly every case, and I have found in practice that a machine whose hump speed curve projects shortly and sharply through the power available will give little or no trouble in taking off, although theoretically it cannot leave the water at all. On the other hand a machine whose power required clings closely to but does not necessarily project through the power available curve is much more difficult in operation. It would appear to be a question of acceleration rather than actual power. In the first case the machine passes through the hump speed with a momentum acquired by early acceleration, and in the second case the machine is unable to accelerate sufficiently to realise this condition.

This feature of the water resistance is the principal one in which the designs of seaplanes are limited in comparison with that of aeroplanes, for in addition to the necessary power to overcome it, it is impossible to use the most efficient propeller from the point of view of speed, and further in order to obtain a propeller that shall give a high thrust at low speed it is necessary to use a larger diameter than would be the case for the land machine propeller. This, again, re-acts on the machine by increased weight of chassis to give the required clearance, and the large propeller diameter hampers certain seaworthiness conditions as mentioned previously.

In one respect the large diameter and low pitch of the propeller are no disadvantage, and result in an improved climb after the machine has left the water.

This question could be dealt with in two ways—one by

the variable pitch propeller, on which much experiment is now taking place. Given control on the pitch very much improved results could be obtained and greater loads lifted for a given power. An alternative, and seemingly easier solution, would be the provision of a two-speed gear on the engine, the gear ratios being arranged so as to give maximum engine revolutions under two conditions—(1) at hump speed for the machine, (2) at maximum or cruising speed, according to which was desired.

This is a course I have been advocating for some time, and I would take this opportunity to impress upon engine designers the urgent need of this feature for seaplane work. It would seem that an engine fitted with an epicyclic gear would be particularly adaptable for this purpose, as it would avoid the necessity of a clutch or gear-changing mechanism. The alternative gear could be engaged by means of a brake-band exactly in the manner of a Ford car, and the only necessary operation by the pilot would be to hold in a low gear until the machine had passed the hump speed.

Comparison with the Aeroplane

Mr. Fairey showed a set of curves of percentage structure weight of a number of existing machines. The curves, he continued, appear to illustrate the writer's suggestion that the average of advantage lies with the float type for small machines and the boat for big ones, and further that large flying boats should be superior in performance to large aeroplanes, while large float types show enough promise to justify experiment with them.

The most striking curve is that of the flying boat. This, starting at a very great disadvantage to the aeroplane, overhauls it in medium sizes and passes it in large sizes, and in the biggest machine yet built shows even further improvement with no sign of the curve turning up. In other words, the limit for big seaplanes is far from reached, whereas that of aeroplanes, while not necessarily in view, will obviously be met first. Moreover, it would appear that the bigger aeroplanes get the greater will be the difficulty in this respect. (One large German giant machine has no less than eighteen wheels for its support.) The difficulties in handling large aeroplanes are tremendous. They need unduly large aerodromes, which must have a hard surface, and most flat country suitable for aerodromes is of a soft nature, whereas the large flying boat has an unlimited " aerodrome." It does not need the rate of climb for safety in taking off that an aeroplane does, and does not present the same difficulties in handling.

On the theoretical basis alone there are many reasons why the overall size of both aeroplanes and seaplanes is strictly limited, but the practical results obtained appear to indicate that the limiting size is very much larger than would be anticipated from theoretical conditions. Also it must be remembered that in none of these curves are safety factors taken into account, but since many types are taken this would average out to a certain extent, and since the larger machine by its steadier flight, and the fact that there is no need to design it to the strength of the fighting scout, has a natural advantage in this respect, it is only fair that this should be taken account of in considering the average effect.

In short the curves would appear to show (subject to any criticisms that may be made of the basis on which they are plotted) the outstanding advantages that the seaplane possesses over the aeroplane that its proper place is in large sizes; it is not limited by the size of aerodromes or the necessity of clearing obstacles after leaving the ground; it cannot be bogged as large aeroplanes will be, and is used on anything but the hardest aerodromes. While inferior to the aeroplane in small sizes, the seaplane would appear to have overwhelming advantages in large sizes if these are properly developed.

One other theoretical consideration should be mentioned in view of the fact that the seaplane, unless for use on inland rivers, is not limited by the size of the aerodrome. It would appear at first sight that some advantage could be taken of this fact with a view to increasing the wing loading with corresponding effect on the landing speed. Unfortunately for small machines this is not the case. Landing speeds of 45 knots or thereabouts appear to be the practical limit, partly because a running landing is not always possible and the machine must have a landing speed at least low enough to make a semi-stalled pancake landing, but also because the high wing loadings would result in raising the power required curve at low speeds owing to the fact that proportionately less of the total weight would be taken on the wings and the old difficulty of the hump speed would be exaggerated. In this respect, however, it is suggested it is not that the landing speed of the seaplane is too low, but that of the aeroplane much too high, and that for equivalent landing speeds the seaplane is in reality much the safer of the two.

In conclusion I had hoped to be able to deal with some commercial aspects of the seaplane, particularly in regard to its future possibilities, but I have found that even to deal in outline with a few outstanding practical and theoretical problems has already absorbed the available time, and provided more subjects than can be usefully dealt with in discussion. I can only hope that this matter will be dealt with at some future Conference, or possibly in discussion, for it is important that the commercial possibilities of the seaplane should be appreciated by the general public in addition to designers and others immediately concerned with the problem.

There is one other important aspect of the seaplane question to which I would like to refer. There is an idea growing common that British designs lead the world. There is enough truth in such a statement in relation to the structure and performance of British machines to make it dangerous to future progress. Design and construction of experimental machines is only a part of the problem. Principles can be established by research, and the arrangement and construction of machines more or less perfected in a few examples of machines, but before seaplanes or aeroplanes become practical

APPENDIX

Classified List of Existing Modern Seaplanes

	Gross Wt.	Useful Load.	Structural Weight.		Wt./H.P.	Wt./sq.ft.
	lbs.	lbs.	lbs.	%	lbs.	lbs.
Flying Boats Single-Step Type						
Besson Triplane ..	1,910	590	955	50	14.5	5.9
N.T. 2.B	3,169	848	1,470	46	14.95	7.1
Macchi	3,540	1,100	1,560	44	14.2	7.3
Farman 450 h.p. ..	6,380	2,200	2,600	40	14.2	7.2
N.C. 4	28,000	12,900	9,800	35	16.7	11.7
Flying Boats Two-Step Type						
Supermarine Schneider, Cup Winner (1922)	3,274	800	1,110	34	6.9	
Nieuport	3,850	1,325	1,735	45	19	7.6
Dornier	4,400	1,440	1,800	41	23.8	8.8
Savoia S.16.. ..	4,620	1,760	1,850	40	16	8.1
Supermarine Seagull	5,680	2,000	2,180	38.4	12.2	
,, Amphibian	5,700	1,960	2,280	40	16.2	
Viking IV ,,	5,675	1,872	2,121	37.4	12	9.4
F.3	11,900	4,250	4,750	39.8	16.5	7.3
P.5	12,055	4,700	4,330	35.8	16.75	
Short Cromarty ..	19,700	7,412	7,310	37.1	18.75	8.77
Felixstowe Fury ..	27,700	11,500	9,200	33.2	15.4	8.75
Atalanta N.4 ..	32,000	11,700	10,300	32.2	12.3	11.1

Float Seaplanes Twin Float—Single-Step Type						
P.V.2	1,590	503	787	49.5	15.9	9.5
,, Bis	1,702	491	911	53.5	17	9.5
184 Short	4,500	1,020	2,080	46.3	18	6.5
Ricci R.1.C.. ..	10,600	4,000	4,230	40	15	8.2
Float Seaplanes Twin Float—Double-Step Type						
P.V.5a	2,518	546	1,217	48.3	12.6	8.1
Fairey Pintail III (Amphibian) ..	4,700	1,350	1,950	41.5	10	10.7
Caudron	6,750	2,000	3,200	47.5	17.4	7.2
Float Seaplanes Twin Float Type, intermediate between the Single-Step and the Double-Step Types						
Avro Polar Expedition	1,589	589	687	43.2	18.7	9.23
P.V.9	1,965	561	960	49	13.1	8.65
Avro Viper	2,567	604	1,170	45.5	12.2	7.92
L.V.G. W.II ..	2,650	650	1,220	46		
Junkers (Duralumin construction) ..	3,120	1,105	1,100	35.4		
L.V. W.I	3,460	810	1,370	39.5		
L.F.G. V.20 ..	3,475	1,275	1,320	38		
Short N.2b	4,938	1,586	1,852	37.5	14.3	7.05
Fairey III.D ..	5,050	1,650	2,020	40	14	10
,, Atlantic, Mark II	7,150	3,100	2,600	36.3	20	10

propositions whether for naval, military or commercial purposes they need a long stage of development. Only practical experience of conditions in operation will provide the designers of the country with data on which to improve still further all classes of machine, and there is not nearly enough information of this kind available. This case applies more particularly to seaplanes than to general aeroplane design. Questions of seaworthiness, handling, etc., can only be solved by full-scale experiment. Even after ten years of seaplane flying, there has as yet been no proper comparison ever made of the relative seaworthiness qualities of various types. Such questions as landing and handling in rough seas are still largely a matter of speculation. A great step in this direction has been made by the recent formation of the Development Squadron of the Royal Air Force, and this scheme should provide exactly what is wanted by the designers if carried out on a sufficient scale.

It must be remembered that during the rapid development of the War years the seaplane benefited constructionally by the harder conditions it was obliged to face. To a certain extent it may be said that the aeroplane was improved by enlarging and rolling the surface of the aerodromes. The seaplane having sea conditions to face naturally evolved as a sturdier structure and these harder conditions account in part for its greater structure weight, but it has now reached a stage when designers are definitely awaiting data before proceeding. They need experience of the large types already built before proceeding to still larger ones.

With reduced structure weights and larger machines the range will be greatly increased, and although by flying overland the commercial aeroplanes may shortly reach India and Australia, if communications are to be established throughout the Empire without crossing foreign territory this work will have to be done by seaplanes, and, with proper development, I suggest that they are the most promising apparatus for the purpose.

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NOTICES TO AIRMEN

Holland : (1) Aerodrome Regulations ; (2) Rotterdam Aerodrome

1. *Aerodrome Regulations* :—(*a*) *Circuit Rule at Schiphol and Rotterdam.* In future all aircraft arriving at or starting from Schiphol and Rotterdam aerodromes, or flying in the immediate vicinity of these aerodromes, shall, when making a circuit or partial circuit, invariably turn left handed (anti-clockwise).

(*b*) *Schiphol : Traffic Control.* The regulation of traffic on and in the neighbourhood of Schiphol aerodrome is, until further notice, entrusted to the Manager for the Koninglijke Luchtvaart Maatschappij voor Nederland en Kolonien (K.L.M.), Schiphol.

2. *Rotterdam Aerodrome* :—(*a*) *Aerial Lighthouse.* The characteristic of the lighthouse at Rotterdam aerodrome has been changed. The light is situated in the N.E. corner of the aerodrome at a height of 73 ft. above the ground ; it is now a group flashing light with a period of 20 seconds, having as characteristic signal the letter "W" of the Morse code, as follows :—Flash, 1⅗ seconds ; Eclipse, 1⅗ ; Flash, 5 ; Eclipse, 1⅗ ; Flash, 5 ; Eclipse, 5.

(*b*) *Levelling Operations.* Work of ploughing and levelling in the north-east corner of Rotterdam aerodrome is now in progress. The area dangerous for landing is marked by white boards which, when necessary, are illuminated at night.

3. *Previous Notices* :—Paragraph 1(*a*) of Notice to Airmen No. 117 of 1922 is cancelled by para. 2(*a*) of this Notice.

(No. 9 of 1923.)

Air Pilotage Marks

1. THE following is a complete list, superseding all previous lists, of British aerodromes, railway stations and towns which have been marked with their name as a guide to pilots :—

(*a*) *Royal Air Force Aerodromes.*—(i) Marked in chalk on the ground : Andover, Biggin Hill, Bircham Newton, Digby, Donibristle, Duxford, Eastchurch, Farnborough, Gosport, Grain, Halton, Hawkinge, Henlow, Kenley, Leuchars, Manston, Martlesham Heath, Netheravon, Old Sarum, Orfordness, Shotwick, Smoogroo, Spittlegate, Stonehenge, Upavon, Watford, Worthy Down. (ii) Painted in white letters on the roofs of sheds : Cranwell, Frieston, Spittlegate.

(*b*) *Civil Aerodromes, Railway Stations, and Towns.*—(i) Marked in chalk on the ground : Aylesbury, Ashford, Burgess Hill, Banbury, Bentley, Bletchley, Cambridge, Colchester, Cranbrook, Croydon, East Grinstead, Edenbridge, Haslemere, Huntingdon, Lympne, Maidstone, Mayfield, Newbury, Northampton, Oxford, Petersfield, Reading, Robertsbridge, Slough, Thrapston, Tonbridge, Uckfield, Weybridge, Witham. (ii) Painted in white letters on the roofs of railway stations : Brentwood, Hertford.

2. Due notification will be given of any additions to this list.

3. *Cancellation.*—Notices to Airmen No. 4 of 1920 and Nos. 15 and 20 of 1921 are cancelled.

(No. 11 of 1923.)

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Night Flying Trials

THE first trip of the series of night flights on the London-Paris route, which are to be carried out during this month by the Air Ministry, took place on Monday evening last. Unfortunately, heavy fog over France prevented this first attempt being completed according to plan. With all the various lights, both on the aerodrome at Croydon and along the route, in commission, the machine—a D.H. piloted by Alan Cobham—left the Croydon aerodrome shortly after 6 o'clock with three passengers. The departure of the machine was witnessed by a number of officials, Air Conference delegates, and others, and its progress was followed for some time by the aid of its navigation lights. When in the neighbourhood of Folkestone one of the passengers, a representative of the Press Association, succeeded in speaking *via* the Croydon wireless receiving station, to his head office in Fleet Street, where he was heard to say, on an ordinary telephone : "We are leaving the English coast at Folkestone. She is above the cloud, and I can see the French coast." "How do you feel ?" was asked, and, after a pause, the reply was clearly heard, "I am feeling very well." Later a message was received from the Air Ministry stating that the machine had landed at Lympne for the night owing to fog.

The British Industries Fair

THE British Industries Fair—the ninth of an unbroken series—opens on the 19th inst. and closes on March 2.

As usual the Fair will consist of two sections, running concurrently, in London and Birmingham. The former, which is organised by the Department of Overseas Trade, is confined mainly to light goods, such as chemicals, fancy goods, stationery and pottery ; while the Birmingham section, organised by a Joint Committee of the Municipality and the Chamber of Commerce, will display heavier commodities, such as engineering stock, hardware and tools.

We have received a copy of the special advance edition of the catalogue for the London section, which will be held at the White City, and glancing over its 256 pages of text and nearly as many of advertisements, we could not help but being impressed by the indication it gave of the magnitude of such an undertaking as the "Fair." At the end of the catalogue the list of exhibits is given in eight languages.

The British Standard Glossary of Aeronautical Terms

THE British Engineering Standards Association has just issued a Glossary of Aeronautical Terms, which, for completeness and excellent arrangement of the various sections, is truly a remarkable work. This Glossary constitutes a revision of the Glossary of Aeronautical terms issued by the Royal Aeronautical Society in 1919. It is divided into a number of sections, suitably illustrated, covering General Aeronautics, Lighter-than-Air Craft, Heavier-than-Air Craft, Aircraft Engines, Airscrews, Instruments, Armament, Pyrotechnics, Meteorology, and Timber. This latter section in itself forms an extremely interesting and useful work of reference, for it includes a long list of all the important kinds of timber, with the general or common names, scientific and standard names, and also the use, or otherwise, to which each is put in aircraft construction.

In view of the rapid development of the air services, the increasing complexity of aircraft science, the great extension of research in aeronautics, and the growing divergence in technical language, this Glossary should be of considerable value to all engaged in aeronautical engineering.

The Glossary as now revised is still provisional, and will be revised from time to time in accordance with the usual practice of the British Engineering Standards Association.

Copies of the Glossary (Publication No. 185-1923) are obtainable from the offices of the B.E.S.A., 28, Victoria Street, London, S.W. 1, price 1*s.* 5*d.* post free.

THE ROYAL AERO CLUB OF THE U.K.

OFFICIAL NOTICES TO MEMBERS

ANNUAL GENERAL MEETING

THE Annual General Meeting of the members of the Royal Aero Club of the United Kingdom will be held on Wednesday, March 28, 1923, at 3, Clifford Street, New Bond Street, London, W. 1, at 6 p.m.

Notices of motion for the Annual General Meeting must be received by the Secretary not less than 21 days before the meeting, and must be signed by at least five members.

COMMITTEE

In accordance with the Rules, the Committee shall consist of 18 members. Members are elected to serve for two years, half the Committee retiring annually.

Retiring members are eligible for re-election.

The retiring members of the Committee are :—

Wing-Commander W. D. Beatty, C.B.E.
Lieut.-Col. M. O. Darby.
Lieut.-Col. John D. Dunville.
Brig.-Gen. Sir Capel Holden, K.C.B., F.R.S.
Lieut.-Col. F. K. McClean, A.F.C.
Lieut.-Col. Alec Ogilvie, C.B.E.
F. Handley Page.
Rear-Admiral Sir Godfrey M. Paine, K.C.B., M.V.O.
T. O. M. Sopwith.

Any two members of the Club may nominate a member to serve on the Committee provided the consent of the member has been previously obtained. The name of the member thus nominated, with the name of his proposer and seconder, must be sent in writing to the Secretary not less than 14 days before the Annual General Meeting.

Offices: THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W. 1.
H. E. PERRIN, Secretary.

LONDON TERMINAL AERODROME

Monday evening, February 5

THE weather has been particularly unkind to the air transport companies during the last week, and although in and around London it has been quite good, during the latter part of the week there has been a persistent fog at St. Inglevert which practically put a stop to all flying to and from the Continent. On both Thursday and Friday the only service to be run was that of the Daimler to and from Manchester.

Although the passenger traffic is well above the figures for the corresponding period of last year, it is by no means brisk. On the Paris line, of course, there are a fair number of travellers whatever the time of year or weather, and Handley Page Transport appear to have little difficulty in getting fair average loads at all times. But business on both the Amsterdam and Cologne routes is, to say the least, disappointing.

The Night-Flying Experiments

FURTHER night flights have been made during the week, and the lights on the British section of the London-Paris route were thoroughly overhauled and tested in preparation for the inauguration, on Monday, of the month's experimental night service. An R.A.F. Bristol fighter has made several flights along the airway ; also a number of landings at Croydon with the aid of various lighting devices. On Friday last Maj.-Gen. Sir W. S. Brancker was to have made a night flight to see for himself the appearance of the various lights from the air, but was prevented from getting to Croydon by a last-minute appointment. There has been particular activity in connection with the Strontium flare, which is fixed on the top of the permanent hangars, and which throws a brilliant red light at intervals. This light is automatic in action, being an acetylene flare into which Strontium is injected to give it fog-piercing qualities.

The Italian Air Attaché in London, Major Carlo Graziani, was a passenger by the Daimler Airway to Amsterdam on Wednesday, being on his way to attend a conference at the Hague on the Rules of Warfare. I understand that Signor Moussolini, the Italian Premier, is an aviation enthusiast, and has intimated that it is his desire that Italian officials shall, when travelling on official business, make use of the air services whenever possible. I gather also that Major Graziani's flight was the first made since this intimation was issued. This is a step in the right direction, and it would be a great help to civil aviation if other countries followed the same course.

A British Machine for Trials in Madrid

DURING the week the D.H.9a, with the Rolls-Royce engine, which the Aircraft Disposal Company have erected, flew to Madrid to take part in some international air trials to be held there. This machine is fitted with five machine guns, and is protected by them from attack from all quarters. It has also a good turn of speed, and, from observation while it was on trial flights at Croydon, appears to be capable of something in the region of 150 m.p.h.

The boom in wireless is bringing grist to the airways. Many firms are importing large quantities of wireless material from France and Holland, and, owing to the enormous demand, and the consequent necessity for rapid delivery, are having their goods sent by air. Dozens of cases of this class of material have been brought over from Paris by both the Handley Page Company and the combined French air lines during the past week.

The spell of dry weather has enabled the authorities to get the upper hand of the sea of mud which was fast developing in front of the departure platform, and new extension platforms have been built out from the central stretch of tarmac, so that there are now several points at which machines can draw up instead of all crowding in one place and churning up the surface of the aerodrome.

Monday night

The first aeroplane, in connection with the month's test of night flying between London and Paris, left the air station at 6.30 p.m., piloted by Mr. Alan Cobham. On board, in addition, were Capt. Biddlecombe, of the Air Ministry, also a couple of passengers, one of whom was a representative of the Press Association. This last-named passenger was to write a description of the flight.

Soon after the first scheduled night plane had left, a Handley Page 0.400, with Maj.-Gen. Brancker as one of its occupants, went up from the air station and cruised round testing the lighting. From the 'drome, as the machine was in flight, one could see clearly the searchlight at Biggin Hill.

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Italy to Expand Her Air Fleet

THE Italian Committee on Foreign Affairs, of which Signor Orlando, the ex-Prime Minister, is President, has, the Rome *Times* Correspondent states, just issued its report, which will come up for discussion as soon as the Italian Parliament meets, on the Washington Naval Treaty. Although Italy has decided on a large increase in personnel and a formidable building programme in respect of light cruisers and destroyers, she will apparently be content to accept the limitations imposed by the Treaty upon the expansion of her battle fleet. The position is that the Italian Naval Department is a convinced believer in the contention of Admiral Sir Percy Scott that big craft will be useless in future against submarine and air attack. Official circles hold that the Italian control of the Mediterranean can best be accomplished through the creation of a powerful air force, the plans for which are in final draft. The existence of this air force will, it is hoped, induce Britain to realise the value of Italian friendship. It is not surprising, therefore, but none the less welcome, that the Foreign Affairs Committee has been able to praise both the spirit and the letter of the Treaty.

International Air Traffic Association

REPORT is to hand of the ninth Meeting of the Central Office of the International Air Traffic Association, established about three years ago, held at Wiesbaden on January 29 and 30.

The questions discussed included collaboration between the different air lines, so that it will be possible to go from London to Berlin by aeroplane, from Berlin to Konigsberg by night train, and from there to Moscow by aeroplane, in about 30 hours ; from Copenhagen *via* Amsterdam, Paris, Toulouse, to Casablanca, with night train between Hamburg, Amsterdam and Paris-Toulouse, in about 60 hours. It was decided to open the summer-time services on April 15. The time-tables for the different lines, which cover nearly the whole European air routes, were fixed.

It was decided to hold the next meeting at Brussels in the coming midsummer.

GLIDING, SOARING AND AIR-SAILING

Those wishing to get in touch with others interested in matters relating to gliding and the construction of gliders are invited to write to the Editor of FLIGHT, *who will be pleased to publish such communications on this page, in order to bring together those who would like to co-operate, either in forming gliding clubs or in private collaboration.*

IT is now learned that the record established by Maneyrol on January 29, when he flew for 8 hrs. 6 mins. at Veauville, near Cherbourg, was officially observed, and that therefore it will doubtless be homologated. Maneyrol was flying the Peyret tandem monoplane glider which he used at Itford, and as there was plenty of wind the machine was in its element. Controllability it possesses in an astonishing degree, and given a sufficiently strong wind this machine should be able to remain up as long as the pilot can "stick it."

* * *

IT begins to look as if 8-9 hours is about the limit of a pilot's endurance. At the Biskra meeting Barbot, on the Dewoitine glider which met with a regrettable accident at Itford, succeeded in beating Maneyrol's performance by remaining up for 8 hrs. 36 mins. 56 secs. It is a remarkable commentary on the organisation of the Biskra meeting that, although the flight by Barbot was made after the official opening of the meeting, no official observers were present. Thus poor Barbot has had all his trouble for nothing, and apparently he had a pretty rough time of it, as he was prostrate when he landed, and had to be lifted out of the machine. At Cherbourg Maneyrol had to battle against rain and snow, while at Biskra Barbot was greatly troubled by the glaring sun

* * *

ANOTHER interesting item concerning gliding is that in the flight made by Bossoutrot on the Farman "Moustique" recently near Etaples he was violently sea-sick. Nevertheless, he stuck to his task for 3 hrs. 42 mins. It thus appears that the sport of gliding is not necessarily as easy and comfortable as might be imagined. On the other hand, it should provide excellent training for pilots, both in the matter of controlling a machine, and also in getting used to fairly violent movements when in the air. Both qualities are required in a pilot of power-driven aircraft.

* * *

HAVING proved that a glider can "sit" on a jet of air for a whole day, there is, as already pointed out in these columns, little scientific information to be gained by continuing to increase duration. That it will be increased may be taken for granted. Probably the next step will be a two-seater dual-control machine, in which two pilots can relieve one another. Provided the wind holds there does not appear to be any reason why a machine should not stay up for 24 hours, or even more. But from a scientific point of view there is nothing in it. We shall now have to experiment with distance, altitude and similar flights in order to learn anything, and that is one reason why we welcome the competition for the Selfridge Prize of 1,000 Guineas, which is for a flight of 50 miles measured in a straight line between the point of departure and the point where the machine alights. Particulars were published last week. It would be well if several minor prizes were offered for other performances, such as altitude, controllability, etc.

* * *

COL. ALEC OGILVIE, in a paper read before the Air Conference, draws attention to the painstaking care the Wright brothers took in getting their early gliders controllable before venturing to put an engine in a machine, and makes the deduction that the problem of aeroplane control might not have been solved at the present time had not the glider proved an inexpensive instrument for getting at the fundamental problems of control. As it is admitted that aeroplane control is not yet all that it might be, especially at low speeds, or rather at angles of incidence near the stalling angle, it would appear that here is a field for inexpensive full-scale research in the form of relatively inexpensive gliders. Col. Ogilvie appealed to business men to come forward and offer prizes so that some of these problems might be attacked and, it is hoped, solved. We heartily support this appeal, and feel certain that in this manner not only would the new sport of gliding be greatly assisted, but, what is more important still, valuable information might be gained which could be applied, suitably adapted, to the conditions obtaining in commercial power-driven aircraft.

* * *

A COMPETITION for designs for a glider suitable for school work is being organised in Germany. A prize of 150,000 marks is being offered, to be known as the Paul Koechl Prize, and the organisers of the designing competition are the Wissenschaftliche Gesellschaft für Luftfahrt (Scientific Aeronautical Society). The last date on which designs may be sent in is June 1, 1923. The competition is for German subjects only, so that no Briton need cast envious eyes at the dazzling prize of—at present rates—one pound sterling.

* * *

ORGANISED by the same society is another designing competition, *i.e.*, for a low-power engine suitable for very light machines. This competition is to be known as the "Rhemag" designing competition. As in the case of the glider designing competition, it is confined to German subjects. The prizes are: 1st Prize, 400,000 marks; 2nd Prize, 200,000 marks; and 3rd Prize, 100,000 marks. The engine, which may be either four-stroke or two-stroke, must be able to develop 20 h.p. at the maximum number of revolutions, at which the mean pressure must reach 7 kg./sq. cm. (approximately 96 lbs./sq. in.).

* * *

WITH regard to our own designing competition, we hope to be able to announce the result in a fortnight's time. Both Mr. Handley Page and Mr. Fairey are very busy men, and it is a matter of some difficulty to arrange conferences. Nevertheless, we should soon reach a decision now, and we shall lose no time in announcing it once it has been made. It will be understood that all the designs have to be submitted to the closest scrutiny, and that this necessarily takes considerable time.

PERSONALS

Married

Flying Officer KENNETH ALEXANDER MEEK, M.B.E., R.A.F., was married at St. Thomas's, Portman Square, on January 20, to MARY VICTORIA BIRD PEARCE.

Mr. LOUIS HERVÉ COATALEN, chief engineer of the Sunbeam Motor-Car Co., Ltd., and designer of the Sunbeam aero engines, was married on January 31, at the St. George's Register Office, Prince's Row, to Mrs. VAN RAALTE, daughter of the late Mr. JAMES GRAHAM and niece of Sir Richard and Lady Cynthia Graham.

Group Capt. EDGAR RAINEY LUDLOW-HEWITT, R.A.F., was married on February 3 at St. Marylebone Church, to ALBINIA MARY, widow of CAPT. HENRY ASHLEY, Coldstream Guards.

CHARLES R. STRUDWICK, R.A.F., second son of the late Rev. R. J. A. Strudwick, was married on January 27, at St. Peter's Church, Brighton, to MARY ELIZABETH, only daughter of Mr. and Mrs. ERNEST SANDEMAN, of Clarendon Mansions, Brighton.

To be Married

The engagement is announced, and the marriage will take place quietly in March, of Capt. EDWARD G. H. CLARKE, M.C., the East Surrey Regt., late R.A.F., younger son of the late Capt. Charles Clarke and Mrs. Clarke, and CORNELIA MARTIN, second daughter of General W. E. WILDER, United States Army (retired), of Newport, R.I., and the late Mrs. WILDER.

The engagement is announced between Flight-Lieut. E. J. WEBSTER, D.F.C, R.A.F., grandson of Mr. E. W. Martin, J.P., of The Manor House, Ewell, Surrey, and DOROTHY MARGUERITE, elder daughter of Mr. and Mrs. F. G. JONAS, of Wood Lea, Woldingham, Surrey.

Items

Major CARLO GRAZIANI, Air Attaché to the Italian Embassy, left by aeroplane on January 31 for The Hague, to attend the Conference on the laws of warfare.

Lieut. Aviateur CHEVALIER WILLY COPPENS, Air Attaché to the Belgian Embassy, returned to London on February 6, from St. Moritz.

AMERICAN SUCCESS WITH ALL-METAL WINGS

Novels Methods of Construction

In view of the attention now being paid to all-metal construction of aircraft, and more especially as we have recently published extensive illustrated descriptions of a number of French and one German all-metal machines, the following account of a set of metal wings built for the American H.S.3 flying boat should be of interest. So far as we are aware, the use of three tubular members to form a spar flange, or, as it is called in the following article, which we publish by courtesy of our New York contemporary *Aviation*, spar "chords," is new, and it is of interest to note that the material employed is mild steel tube. Thus *Aviation* :—

In February, 1920, the United States Navy invited bids for furnishing two sets of experimental all-metal wing frames for an H.S.3 flying boat, and in May of the same year awarded a contract to Charles Ward Hall, Inc., New York, to design and furnish these. Three generally similar designs were submitted with bid, one involving the use of Duralumin throughout with steel for wires only, the others based upon the use of steel tubing for spars and struts, with steel wires and Duralumin ribs and edges. The Navy selected the design involving the use of Duralumin throughout, but after waiting a year for the delivery of the tubing required for spar construction, steel tubing was substituted therefore, and the first wing set completed and shipped January 11, 1922. The second set was completed April 26, 1922.

The guaranteed weight of the complete wing frames was 872 lbs., plus a manufacturing allowance of 25 per cent. The weight of the wings as shipped was 852 lbs., including non-skid planes and their wires at 8 lbs., which were not originally estimated. The weight saving within the guarantee was due mainly to refinement of the spar joints, refinement of the strut fittings, and by use of thinner sheet for the nose stiffener, all of which changes were justified by detail tests.

Sand Tests

The wings as shipped to the Naval Aircraft Factory, Navy Yard, Philadelphia, were first set up on an H.S.2 hull, and proved to be free of any errors in dimensions. They were next set up on a testing jig and sand loaded pursuant to Navy Technical Note 107 as viz. :—Uniform distribution along the span, the forward 60 per cent. of the chord uniformly loaded with 80 per cent. of the weight, the after 40 per cent. of the chord with 20 per cent. of the weight ; the ratio of unit loads for upper and for lower wings being 11 to 9. The average chord was inclined at 15° to the horizontal, leading edge uppermost. Loads were applied in units up to the fifth load, and thereafter in one-half units to a factor of six. Readings for deflections, both vertical and horizontal, were taken at all panel points, and on the spars midway between panels. Extensometer readings on lift, incidence and external bracing wires were also made.

The deflections were consistent and substantially uniform throughout the test. Under maximum load the average vertical deflection of the upper front spar at most outboard lift wire was $2\frac{7}{8}$ ins. ; the corresponding point on the rear spars deflected $3\frac{1}{4}$ ins. ; at the outermost strut the average deflection due to drift was $1\frac{5}{16}$ in.

Upon removal of the sixth load factor no measurable permanent set was found, nor were any details of the wing structure injured or deformed by the loading.

Under a separate contract this sand loaded set of metal wings have been conditioned and accepted for flying service, a very creditable performance when it is considered that the weight thereof was only 65 per cent. of that of their wooden counterparts.

Trial flights at Philadelphia Navy Yard showed a high speed of 90 m.p.h. against 85 m.p.h. for the wooden wings ; climb to over 6,000 ft. before the rate of climb dropped below 100 ft. per min. ; and climb to 7,400 ft. in 30 mins.

Principles of Design

The reasons for this remarkable performance do not lie in a mere change of material ; but in a thorough and complete analysis of the actual stresses due to loading, including all secondary effects ; and in the correct proportioning of the parts thereto.

In the order of their relative importance these causes may be stated as, viz. :—

(*a*) The balancing of one secondary stress against another in such manner as to cancel both, or to cancel one and to materially reduce the other of them wherever practicable. The introduction of secondary stresses to relieve the free edges of unsymmetrical sections. Wherever secondary stresses cannot be utilised to advantage, the elimination of them by use of concentric joints or otherwise.

(*b*) The use of a strictly uniform factor of safety throughout, having due regard for the true stress maxima to which any part might be subject in any condition of flight or landing. No detail too small or too inconspicuous to receive full consideration.

(*c*) The use of cross sections of 100 per cent. efficiency throughout, save only where the bulk of material required does not permit of such sections, and for these the use of the most efficient section available.

A few examples of these principles of design are shown in the accompanying illustrations.

Fig. 1 shows one of the lower inboard wing panels completely assembled ; a similar general arrangement pertains to all panels. The spars are built up of six mild steel tubes for chords, with a lattice web system also of steel tubing. The drag wires are steel as made by the Stewart Hartshorn Co. All other parts are Duralumin, the drag struts being $1\frac{1}{8}$ in. or $1\frac{1}{4}$ in. outside diameter and varying in wall thickness to correspond to the loads sustained.

Ribs are punched and pressed from Duralumin sheet, for convenience in assembly having been made in three sections ; they are braced sidewise by lacings of Duralumin sheet $\frac{1}{4}$ in. by .02 in. in cross section. The leading and trailing edges, as also the nose stiffener, are drawn to special forms from sheet.

Wing Panel Connections

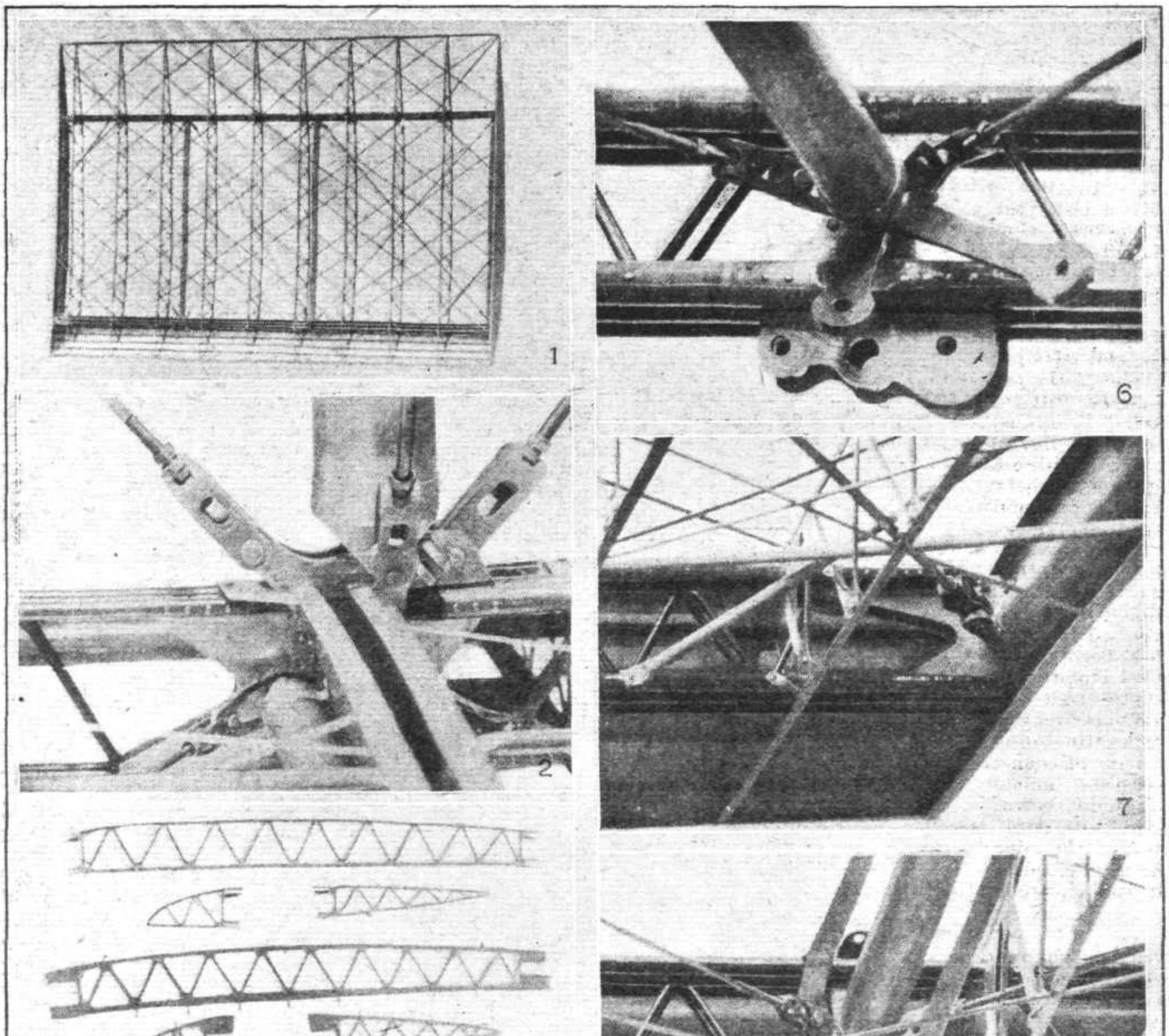
In the connection of one wing panel to the next it has been customary to use a horizontal pin passing through the centre of gravity of the spar section, and so resulting in a zero bending moment at the panel ends. In these wings this pin is horizontal, but is so far eccentric to the gravity axis of the spar that the product of its eccentricity by the end thrust or tension along the spar, results in the same bending moment at the panel joints as would have occurred if no joint were present. This has the effect of reducing the support moments and increasing the centre moments in adjoining panels (see Fig. 2). Substantial increase in the ratio of weight carried to weight of structure results.

Truss members such as spars, being subject both to end load and to bending, are necessarily deflected thereby. If originally straight between the panel points the bending moment due to column action is additive to and increases with the bending due to beam action, and at full loads becomes a large proportion of the total. In these spars a sinusoidal curvature, or camber, contrary in sense to that produced by the beam loading, is used, its amount being such that under maximum stress conditions the member is straight. This, with proper proportions in details, practically eliminates the l/r factor for column action, in the plane of spar webs, and results in marked weight saving.

Another method of obtaining a corresponding result by a shift or bending of the gravity axis of the member instead of curving the member as a whole is shown in the photograph Fig. 3, and other pictures of rib details ; by reducing the width of the sheet near the ends as compared to the width at the middle of the web members, the usual tendency of angle sections to fail either by an outward opening of the angle legs or by a sidewise bending of the angle as a whole is counteracted in the free edges of the section relieved of maximum stress. Sections so proportioned usually fail by twisting instead of bending, and at a much higher average unit stress.

The upper three parts of Fig. 3 show the rib after pressing to form, riveting the reinforcing lugs, punched to receive spar tubes, and trimming off of surplus material.

The use of cupped forked straps straddling a ball head bolt shown in all photographs of joint details, but particularly in Fig. 4, results not merely in enabling the use of a smaller diameter bolt. In fact, the chief weight-saving results in the reduced proportions of the web plates, which transmit a direct push or pull, without twist, to the spar chords ; and in the weight of the spar chords as well. For instance, only $\frac{1}{4}$ in. of eccentricity in the lead of a No. 5 Hartshorn wire might produce a bending moment of 1,425 ins./lb., in the plates and in the spar ; and if in the drift plane, contribute a large proportion of the total bending moment in the case of a small machine. The total weight-saving is far more considerable than might be inferred from a casual glance at this rather simple fitting.



Some details of the Hall all-metal wing built for H.S.3 flying boat.

Terminals at Spar Joints

The principles of design below noted for this single wire terminal apply also to all of the more complex terminals shown by the spar joint detail photographs. It will be seen that the strap is deeply cupped at the centre to spherical form, its interior fitting the spherical inner side of the bolt head. Two forks lead off from widely-separated points on the rim of this cup, conformably to the lead of the wire, so that its line of action intersects the axis of the bolt at the bolt head. While the use of a ball head instead of a standard bolt to secure a flat strap having an angular lead represents a considerable reduction of bending stress on the bolt as compared with a lead past a flat head bolt, the device here illustrated entirely eliminates this bending stress, and for angles of lead of about 45° to the bolt axis, the strength of the bolt is practically twice that in the usual ball head arrangement. For more acute angles the relief is proportionately greater. When used in connection with a strut bearing upon the outer spherical bolt head surface, the stress in the bolt is pure shear, and tests prove the bolt to have realised the full shearing value of the material.

Fig. 5 shows drift tube sockets. These sockets are used in two sizes: 1½ in. diameter, weighing 1 oz., with breaking strength of 12,750 lbs. applied as in use; and 1¼ in. diameter, weighing .6 oz., with breaking strength of 10,000 lbs.

For Duralumin, the ratio of shearing strength to tensile strength is low as compared to the like properties of steel. Cone-shaped compression tips for tubular struts as usually designed fail in shear and bending, the more pointed parts telescoping through those of larger diameter.

Through consideration of the underlying fundamentals it was possible to design the cone fitting shown in Figs. 4 and 5, which are used for all drift strut ends, wherein the type of failure has been changed from shearing to tension, four symmetrical longitudinal cracks developing upon the outer surface of the cone as the first indication of failure. The weight for like strength of these fittings is about one-third that of such fittings of usual proportions.

Eccentricity of connections, except where useful as above noted, has been eliminated by the device of fully concentric joints. In joint shown in Fig. 6 the lines of action of the spar, of the drift strut, the drift wire and its counter, the incidence wire, the interplane strut, the lift wires and a stay rod to the engine bed all centre in a common point, the ball head bolt passing through the joint plate.

Panel Joints

The panel end shown in Fig. 7—where, the load transmitted being large, the gusset plates are conspicuously tapered and resilient at their contact with the diagonal web system—demonstrates one of the causes of the light weight and high strength of the H.S.3 metal wings. Another method of assuring such resiliency at joints is shown in Fig. 8, typical of all drift panel joints, in which the Y-shaped plates not only are lighter than rectangular ones would be, but diminish secondary stress in the spar chords adjoining.

The use of external control wires leading from the front spars to the aileron horns unavoidably produces torsional stress in these spars; accordingly the ailerons are mounted upon brackets projecting from the rear spars to such a distance that the aileron loading produces a torsional moment therein equal to that in the front spars, and the lower chord of the front spar being attached by tension bands to the upper chord of the rear spar, and *vice versa*, by balance completely eliminates this torsion. (See Figs. 7 and 8). Bent lugs on upper and lower edge of joint plate attach to pulleys for aileron control. The aileron horn hinge fits between the ends of the U-shaped lug as shown in Fig. 9.

It is obvious that the stresses sustained by various parts of the same class in any wing structure vary greatly. Until recently, however, there appears to have been little, if any, tendency to proportion the parts to the stress. Inter-plane struts of biplanes have usually weighed nearly as much when near the wing tips as when near the centre; the same cross sections have been used for lower as for upper spars, and but little if any change of cross section has been made along the length of the spars, even with biplanes of high aspect ratio. Ribs have usually had uniform size cap strips from end to end, and if trussed the web members were all of one size.

In many airplane parts there is a distinct maximum of the combined stresses due to axial and bending loads at the panel points; in wooden construction this is commonly provided for by interrupting the spar routing at such points. This addition to cross section is inefficient, being an increment to the web member and not to the chords, which latter carry the peak load of the stress.

A method of reinforcing the chords at the panel points by overlapping the tubing of adjoining panels, suitably tapering the thickness of the tube walls to a feather-edge at the tips and sweating together with solder, results in a joint that develops the full strength of the tubes. It also affords any desired cross sectional area over the supports without increase of weight at any other places. (See Fig. 6.)

It is essential to taper the thickness of the tube walls so gradually that increase of the strength thereof in a given length is less than the bonding value of the solder for the same length. To afford the incidence wire anchorage a concentric lead one chord tube is flattened about half way. It will be noted that where this device is employed the least stressed of the tubes is the one flattened; that is to say, the tube in which the bending stress due to lift or both lift and drift is of opposite sign to the axial stress resulting from its position in the wing truss entire.

Rib Construction

For the rib proportions note particularly on the blanks (the three lower parts of Fig. 3) the variation in size of the truss members, the large tapering fillets which connect the web members to each other and to the chords the lugs at each panel point which bend up and are riveted to the web fillets to brace the outer edge of the lower chord of centre part, of the upper chord of nose part and of both chords of tail part. The effect of these riveted lugs is to increase the strength of such a rib to 60 per cent. more than the strength of a like rib not having them. The five lugs on inner edges of the centre part which after bending perpendicular to the plane of the rib are riveted to the diagonal lacing. The cross section of the web members is curved to approximately parabolic form, the cross section of the chords is likewise curved throughout. The weight of each rib is 6.61 ozs., and they have carried distributed loads under test of 500 lbs., equivalent to 73 lbs. of load per 1 oz. of rib weight. Other ribs of this type have developed a strength of 120 lbs. of load carried per 1 oz. of rib weight.

The net result of these refinements is a structure wherein the joints weigh less than 2½ per cent. of the total instead of 15 per cent. or more as is common in engineering structures and 25 per cent. or upward in some wooden airplanes.

Wherever possible, tubes of circular cross section have been used for members and parts subject to compression or bending or torsion. For the resisting of torsion or of pure compression a single tube of appropriate thickness and diameter is, if unperforated, 100 per cent. efficient. Where, as in spars, there is considerable bending stress combined with more or less compression, the single tube cannot in most cases compete in efficiency with a trussed form of construction.

For a large plane some tubular combination is doubtless the most efficient for rib sections, but in as small ribs as the R.A.F. 6 section of 6 ft. 3 ins. chord, tubular ribs are unavoidably heavier than those of the type of design used in the H.S.3 metal wings. The stamped and pressed ribs make a good quantity production job, and as they support from 70 to 120 lbs. of distributed load per oz. of rib weight, they are twice to thrice as efficient as the wooden ribs in use.

The use of a torsional tube for aileron control, by the elimination of one of the four sets of horns used on the wooden H.S.3 ailerons, and the omission of all the external bracing wires while not unduly increasing the aileron weight, is believed to afford in reduced resistance the aerodynamic equivalent of several hundred lbs. of weight saving.

A comparison of the weights of the metal and the wooden H.S.3 wings is made in the table which follows:—

	Lbs. for wood construction		Lbs. for metal construction	
	Total	Per sq. ft.	Total	Per sq. ft.
Upper wing panels (without ailerons)	575	1·57	370	·988
Lower wing panels ..	354	1·03	208	.605
Inter-plane struts ..	155	·198	95·16	.122
Ailerons	71·4	1.01	33.19	·471
Lift, incidence and external wiring	142	·182	128.25	.164
Aileron control wires and turnbuckles and leads	17·6	·0025	17·6	·0225
Total ..	1314	1·682	851·20	1·088
Relative weights:	154·5		100·0	
	: 100		64·7	

The principles of design and the details of construction above described are fully covered by patent in the United States and in the principal European countries.

TEN YEARS' TESTING OF MODEL SEAPLANES

MR. G. S. BAKER has had charge of the testing, in the Froude tank at the N.P.L., of scale models of seaplane floats and flying boat hulls ever since such tests commenced to be carried out in 1912. He has therefore had unique experience in this kind of work, and consequently the paper read by him, under above title, before the Royal Aeronautical Society on February 1 was of more than ordinary interest. It is, unfortunately, impossible for us to publish the paper in full, and those wishing to read the complete paper should obtain the forthcoming issue of the *Journal of the R.Ae.S.*, which will contain both the paper and the ensuing discussion.

The first part of Mr. Baker's paper gave an account of the beginning of the tank tests in 1912, and outlined the operation of the 550 ft. by 30 ft. tank, built mainly from funds provided by Sir Alfred Yarrow so that research work on hydrodynamics, marine propulsion, and naval architecture could be carried out in this country. The tank was mainly intended for shipbuilding firms, and has been adapted for purposes of seaplane testing at relatively small expense. Incidentally it is pointed out that work for the mercantile marine has been carried out concurrently with that on seaplanes, with the consequence that progress has been somewhat slow. Mr. Baker expressed the hope that in the future it might be possible to build a really high-speed tank, in which case work could proceed continuously.

The lecturer dealt at considerable length with the early experiments, and gave an account, illustrated by lantern slides, of the manner in which work in the tank is done. Briefly the arrangement is that a travelling carriage, which runs on rails on each side of the tank, carries the balances, indicating and recording instruments, and observers. The carriage is made to run along at some chosen speed, propelled by electric motors. As a result of the various tests, considerable progress has been made, and it is now possible to predict with reasonable accuracy the behaviour of any seaplane hull provided it does not depart too much from existing types. The use of two steps, and the reduction in, or in some cases limitation of, "porpoising," are to a very large extent the result of work in the tank, and although certain features cannot well be reproduced in the tank, there are few points upon which model tests and full-scale tests do not agree with reasonable accuracy.

Future Tests

The last part of Mr. Baker's very instructive paper contains several interesting statements on the subject of future tests, and we therefore reproduce it in full:—

"In the lecture so far the author has tried to show how the experiments in the past have grown in purpose and usefulness, and slowly taken certain more or less standard shapes. It is to be assumed that in the future these methods will grow and change with the types of the machines, and one's endeavour in test work is to keep always a little ahead of such changes, so that the test data serve as a guide to the designer. We are beginning to regard data from two points of view, the small machine and the really big one, leaving intermediate ones for individual consideration. Ten years ago our first research paper dealt with the machines then in use of weight less than 1 ton. Our latest general research paper covered machines of the single-hull type weighing 50 tons: Our other work has dealt with machines mostly of 2 to 5 tons, occasionally of 15 tons, generally of amphibian character, and these for the most part indicate the drift of design. Qualities which are easily embodied in a small machine become more difficult of attainment in the large, and in some cases more essential. The bigger the machine the greater is the accuracy required in the design, and in such machines model tests of all features are imperative. In the small ones, small errors in design are easily eliminated often at less expense than is involved in making tank tests. But new types, especially of amphibian machines, should be tank tested. Special tests at high speeds are now made with these, for trimming when settling on the water, to determine the trimming effect of the wheels.

"Whether the next developments will follow the two general lines of small amphibian and large flying boat cannot be said with any certainty. *In the author's opinion the really large flying boat is coming. The direct trade routes from this country to Scandinavia, the ports of the Baltic Sea, Germany and to America, are almost entirely by water, and all our Colonies are separated from us by great oceans. To carry a large number of passengers large machines are required, and any machine not capable of settling on the water would hardly come up to accepted standards of safety on these routes. Research on such lines should not be deferred until the machines are here, but should be well in advance of the present requirements and should be unrestricted in its general character.*"

[The italics are ours. The opinions expressed by Mr. Baker tally so exactly with views expressed by us in FLIGHT that we wish to draw special attention to them.—ED.]

THE ROYAL AIR FORCE

London Gazette, January 30, 1923

General Duties Branch

Flying Offr. C. H. Stilwell is granted permanent commn. in rank stated; Aug. 31, 1922. Flying Offr. G. Martyn is granted permanent commn. in rank stated; Dec. 12, 1919 (since promoted). *Gazette* Dec. 12, 1919, appointing him to short service commn., is cancelled. Flight Lieut. A. J. G. Styran, M.C., A.F.C., is granted short service commn. in rank stated; Jan. 18. C. H. Brill is granted short service commn. as Flying Offr., with effect from, and with seny. of, Jan. 17. Lieut. W. J. Eldridge, D.S.O., M.C., R.G.A., is granted temporary commn. as Flying Offr. on seconding for four years' duty with R.A.F.; Jan. 12.

The follg. Pilot Offrs. on probation are confirmed in rank:—W. A. C. A. Yearsley; Jan. 4. R. G. Chapell; Jan. 14.

The follg. are transferred to Reserve (Jan. 30):—

Class A.—Flying Offrs.—C. V. Frith, A. Knox, J. H. Vickers.

Class B.—Observer Off.—W. B. Mortimore.

Class C.—Flying Offr.—P. Colbeck, M.B.E.

Flying Offr. A. G. Thackray to take rank and precedence as if his appointment as Flying Offr. bore date Oct. 1, 1919, immediately following Flying Offr. G. Wilson; reduction to take effect from Nov. 2, 1922. Flight Lieut. A. W. C. V. Parr is placed on half-pay, Scale B; Jan. 15. Wing Comdr. (actg. Group Capt.) R. D. S. Stoney, C.B.E. (Lt.-Col. and Staff Paymr., R.A.P.C.), relinquishes his temp. commn. on retirement from the Army; Jan. 3 (substituted for *Gazette* Jan. 2).

Medical Branch

W. B. Stott is granted a short service commn. as Flying Offr., with effect from, and with seny. of, Jan. 15.

Memoranda

P. F. Parton is granted an hon. commn. as Sec. Lieut.: Aug. 14, 1918, Capt. H. D. Briggs, C.M.G., is granted hon. rank of Brig.-Gen., R.A.F., on retirement from Royal Navy.

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

Wing Commanders: W. L. Welsh, D.S.C., A.F.C., from No. 1 Group Headquarters (Inland Area) to Headquarters, Coastal Area (Supernumerary); 15.1.23. A. L. Godman, C.M.G., D.S.O., from Headquarters, R.A.F., Cranwell to Headquarters, R.A.F., India. 19.1.23. E. R. C. Nanson, D.S.C., A.F.C., from No. 4 Flying Training School (Middle East) to R.A.F. Depot (Inland Area) (Supernumerary). 8.1.23. T. O. Hubbard, M.C., A.F.C., from R.A.F. Trans-Jordania Headquarters (Palestine Command) to command Palestine Wing Headquarters (Palestine Command). 22.11.22. J. McIntyre, M.C., M.B., M.A., from Headquarters, No. 1 School of Technical Training (Boys) (Halton) to Headquarters, R.A.F., India. 19.1.23. J. R. W. Smyth-Pigott, D.S.O., from Aeronautical Committee of Guarantee (British Section), Germany, to R.A.F. Depot (Inland Area) (Supernumerary). 23.1.23.

Squadron Leaders: L. T. N. Gould, M.C., from Headquarters, Iraq Comcommand, to Headquarters, R.A.F., India. 7.12.22. J. Kemper, M.B.E., from No. 4 Flying Training School (Middle East) to Headquarters, Iraq Command. 5.1.23. J. Sowrey, A.F.C., from R.A.F. Cadet College (Ground Wing) (Cranwell) to Central Flying School (Inland Area). 29.1.23. H. G. Smart, O.B.E., D.F.C., from R.A.F. Depot (Inland Area) to Central Flying School (Inland Area). 4.2.23. A. J. Capel, from Headquarters, R.A.F., Cranwell, to R.A.F. Cadet College (Ground Wing) (Cranwell). 29.1.23.

Flight Lieutenants: R. Halley, D.F.C., from Half-pay List to R.A.F. Depot (Inland Area) (Supernumerary). 15.1.23. G. C. Anne, O.B.E., from Inland Area Aircraft Depot (Inland Area) to Air Ministry (Dept. of A.M.P.) (D.D.P.). 2.1.23. D. G. Boddie, M.B., from R.A.F. Trans-Jordania Headquarters (Palestine Command) to Headquarters, Iraq Command (Supernumerary). 26.12.22. T. J. Thomas, M.B., from Engine Repair Depot (Middle East) to Headquarters, Iraq Command (Supernumerary). 26.12.22. J. R. Crolius, M.B., from Headquarters, R.A.F., Middle East, to R.A.F. Trans-Jordania Headquarters (Palestine Command). 3.1.23. A. W. C. V. Parr, from Central Flying School (Inland Area) to Half-pay List. 15.1.23. A. W. Cuddon-Davis, from No. 25 Squadron (Constantinople Wing) to R.A.F. Depot (Inland Area) (Supernumerary). 29.1.23. M. Moore, from Headquarters, R.A.F., Middle East, to command Aden Flight (Middle East). 10.1.23. W. E. Hodgins, M.B., from Headquarters, R.A.F., India, to No. 5 Squadron (India). 23.12.22. J. C. Slessor, M.C., from R.A.F. Depot (Inland Area) to Air Ministry (Dept. or C.A.S.) (D.T. and S.D.). 1.2.23. R. H. Hanmer, M.C., from R.A.F. Cadet College (Flying Wing) (Cranwell) to Headquarters, R.A.F., Cranwell. For duty as Adjutant. 29.1.23.

A DE HAVILLAND DINNER

On January 31 quite an informal and certainly very amusing gathering took place at the Criterion Restaurant, when the first dinner to be given by the de Havilland Aircraft Co. brought together personal and business friends of the firm and heads of the various departments in the Stag Lane establishment.

The Chairman, Mr. A. E. Turner, who is chairman of the de Havilland Aircraft Co., welcomed the guests, and caused a great deal of amusement by saying that when the dinner was first suggested, it was at once decided that it should be quite an informal affair, and that the question then arose who should be invited. They could ask some of those who had helped to get orders for the firm, those who *ought* to have got orders for the firm, those who might place orders, and some of those who had prevented the firm from getting orders. It was decided to ask a few very good friends, and he hoped they would enjoy themselves. Mr. Turner said he was glad to say that the firm was doing pretty well, and for that perhaps the tact of the personnel was responsible. As an instance of the tact shown, he mentioned that he had recently received from the secretary a letter thanking him for a subscription which he had not yet sent. That was the sort of tact which got on.

Mr. Jackson spoke very highly (and very frequently) of the experiences he had had while a passenger with de Havilland pilots, and expressed the conviction that they were second to none.

Mr. A. S. Butler, who is a director of the firm, threatened anyone who got up to speak with dire penalties in the form of an apple bombardment, but as he was obliged to leave early his threat had but little effect.

Mr. Alan Cobham, the well-known de Havilland pilot, said that all the pilots did was to do their job. They had the machines, the engines, and a good organisation, and that was all there was to it.

Col. Bristow thought there might be greater significance in this informal dinner than appeared on the surface, and hoped it marked the beginning of a greater importance of aviation. He appealed to all to take a wide view of the commercial possibilities of aviation.

Speakers referred to opportunities and good records of de Havilland machines in Canada and Australia, and Major Buchanan said the Air Ministry would give every support to machines which passed the Air Ministry method of testing.

Squadron Leader Payn, Air Ministry test pilot, spoke very highly of the differential type of aileron control invented by the de Havilland staff, and thought this provided on occasion a means of giving a pilot an extra chance where, without it, he would have none.

Mullion R.N. Airships

The Fifth Reunion will be held at the Temple Bar Restaurant, 287, Strand, W.C., on March 3. Tickets may be obtained from W. G. Lavender, Hon. Sec., 16, Alma Road, S.W. 18.

A Good Climb by "Mars I."

Notification has just been received from the British Air Ministry that the Gloucestershire-Napier biplane, piloted by Flight-Lieut. Haig, whilst on test at Martlesham Heath, climbed to a height of 20,000 ft. in the remarkable time of 12 mins. 24 secs. The same machine has, on two successive years, won the Aerial Derby, and on the occasion of achieving this climb its speed at ground level was 189 m.p.h.

The Gothenburg International Aero Exhibition

The following French aircraft manufacturers have entered for the International Aero Exhibition at Gothenburg, in addition to the space taken by the French Government, who are also sending two Service squadrons to the Exhibition: Henry Potez, 2 machines; Caudron, 3 machines; Société Nieuport Astra and Co., 1 machine; Hanriot, 1 machine; Liore and Olivier, hydroplanes; Radio Electrique, apparatus for wireless telegraphy; Société des Etablissements Aera and Precision Moderne, accessories; Louis Breguet, models and eventually an ambulance 'plane; Hispano-Suiza, motors; P. Levasseur and P. Ratier.

Liore and Olivier are going to send the hydroplane which is at present used in regular traffic between Ajaccio in Corsica and Antibes on the French coast. Fokker has secured space, and also Czecho-Slovakiä, and the U.S.A.

The Aircraft Operating Co., Ltd.

A new aircraft company has just been formed under the name of "The Aircraft Operating Co., Ltd.," the Board of which consists of Mr. Alan S. Butler (Chairman), Mr. H. Hemming (managing director), and Capt. T. P. Mills—partner of the firm of Rider, Heaton, Meredith and Mills—who is secretary. The policy of the company will be to investigate all propositions where British aircraft can be used, especially in the Colonies. The Board have much data and information at their disposal, gained from practical experience, and they are in a position to tender for contracts in connection with aircraft work. As the company does not intend to operate aircraft for the present, the capital, *i.e.*, £6,000, has been purposely kept low for the sake of economy. All the shares are held by the directors. Should the Board decide to go in for operations, however, they have the necessary backing behind them to make this possible. It should be noted that Mr. Butler has resigned his position of chairman and director of the Aerial Survey Co. (Newfoundland), Ltd., and that the new company is not connected with this company. The registered offices of the Aircraft Operating Co. will be at 11, New Court, Carey Street, W.C., but at present all communications should be addressed to the managing director, c/o Rider, Heaton, Meredith and Mills, 8, New Square, Lincoln's Inn, W.C. 2.

PUBLICATIONS RECEIVED

Technical Notes: No. 112, The N.A.C.A. Three-Component Accelerometer. By H. J. E. Reid. No. 115, The Effect of Longitudinal Moment of Inertia upon Dynamic Stability. By F. H. Norton and T. Carroll. No. 116, F-5-L Boat Seaplane Comparative Performance. By Lieut. W. S. Diehl. No. 117, The Synchronization of N.A.C.A. Flight Records. By W. G. Brown. No. 118, F-5-L Boat Seaplane Performance Characteristics. By Lieut. W. S. Diehl. No. 119, The Elimination of Dead Centre in the Controls of Airplanes with Thick Sections. By T. Carroll. No. 120, A Preliminary Study of Airplane Performance. By F. H. Norton and W. G. Brown.

AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations: cyl. = cylinder; I.C. = internal combustion; m. = motor

The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

APPLIED FOR IN 1921

Published February 1, 1923

23,975. J. C. Savage. Smoke trails from aircraft. (191,118.)
25,942. V. L. Oil Processes, Ltd. and O. D. Lucas. Means for controlling fire of automatic guns on aircraft. (191,127.)
27,212. R. E. Ventress, sen. Propulsion of aircraft. (191,189.)
27,790. G. Dinkela. Means for preventing self-ignition of airships, etc. (191,200.)
33,933. H. Junkers. I.C. engines. (173,226.)

APPLIED FOR IN 1922

Published February 1, 1923

3,657. A. Boyriven. Window operating means. (191,300.)
14,654. Skywing Aircraft Corporation. Rotary cylinder I.C. engines. (180,681.)
34,029. Skywing Aircraft Corporation. Water cooling of rotary cylinder I.C. engines. (190,483.)

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